SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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SURFACING AND POLISHING THE ICE FOR THE SKATERS.—[See page 33]

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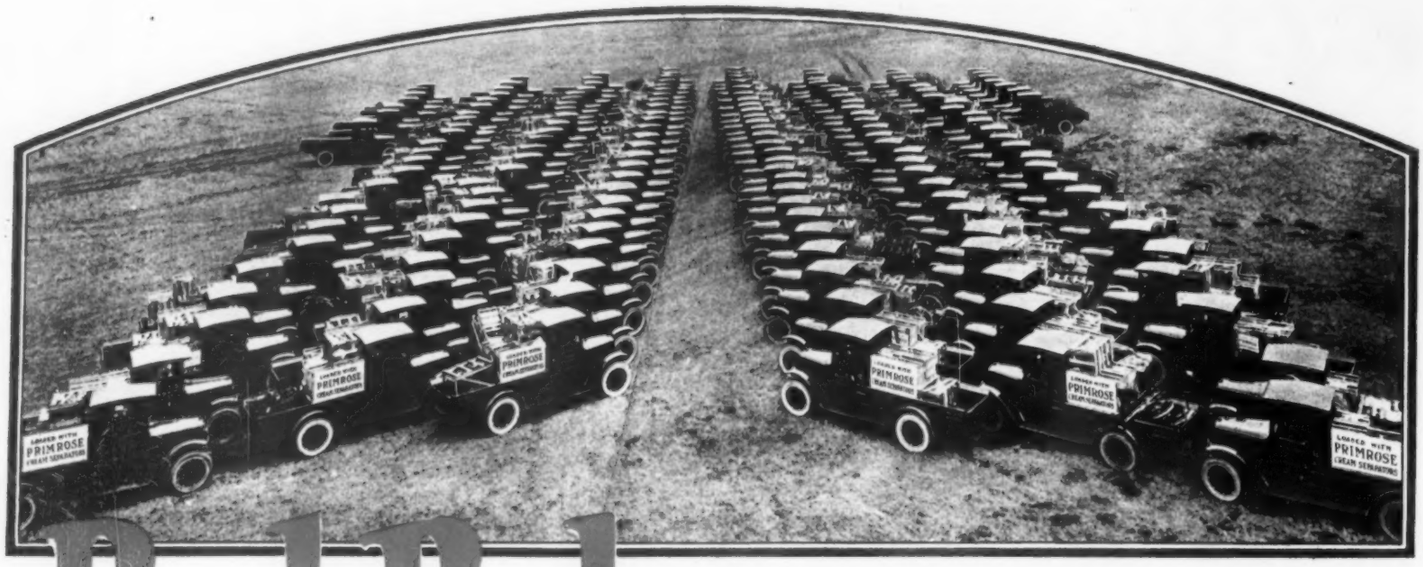


Red Baby: Serves the Nation by Serving Agriculture

ONE DAY, not many months ago, the McCormick-Deering dealers of central Minnesota came to St. Cloud and painted the town red.

It was "Red Baby Day" and the eyes of the motion picture cameras saw the city celebrating. The newspapers issued special editions. Senators and other prominent officials took part in the activities, and business men and farmers in thousands were caught up in a great wave of community enthusiasm.

On that day these McCormick-Deering dealers came into proud possession of the "Red Baby" Service Trucks mobilized in the above photograph. Before night they drove 162 bright-red International Speed Trucks out into the counties around St. Cloud and set them to work—not for re-sale but for actual use in the betterment of farming. Since that day the "Red Babies" have lived on the roads, distributing equipment, information, repairs, and special aid—carrying everywhere the methods that increase production and wealth.

* * * *

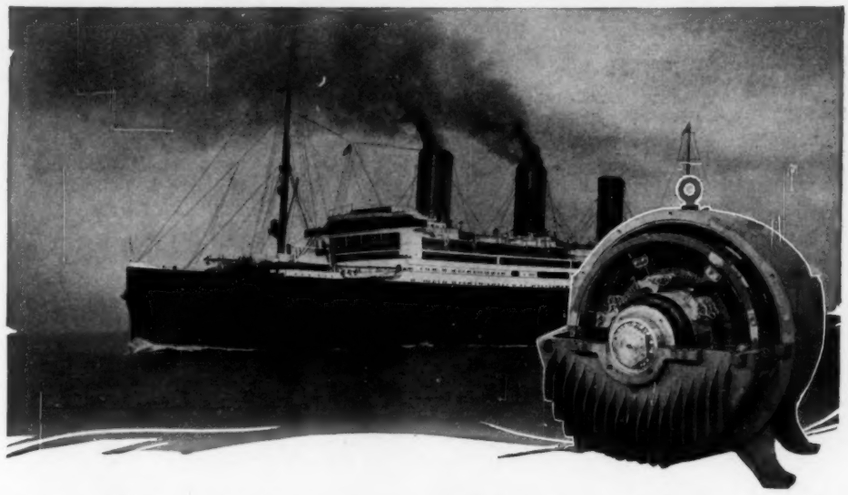
This middle-western incident merely typifies the "Red Baby" enthusiasm that has swept the nation. St. Cloud speaks with a small voice compared with the mighty call for International Speed Trucks that has come from the great McCormick-Deering dealer organization. During this present season a constant procession of "Red Baby" Service Trucks has trailed out of Boston, out of Los Angeles, out of Winnipeg and Jacksonville, out of all International branch house cities into the service of Agriculture.

In a hundred days' time the vast fleet of "Red Baby" trucks, owned and used exclusively by the McCormick-Deering dealers, has given a new value to the familiar term "Service." "Red Baby" has become a household term, the truck a familiar sight and influence in thousands of rural communities. A new demand for modern farming methods is in evidence, and the alert service that doubles the dealer's worth now speeds to the doorsteps of American farms.

Farm products, the staff of life, find their way into cities and over oceans in richer flow because the "Red Baby" is leading the way to better, more profitable farming. The "Red Baby" is rightly called "The Nation's Service Truck."

INTERNATIONAL HARVESTER COMPANY
CHICAGO OF AMERICA (INCORPORATED) USA
93 Company Branches and 15,000 Dealers in the United States

SKF



Leviathan Relies on Ball-Bearing Motors for Continuous Forced Boiler Draft

THE giant ocean liner Leviathan, now being reconditioned, depends upon two 60,000 cu. ft. blowers to supply the forced boiler draft necessary to obtain its high speed of propulsion.

The direct-connected blower motors, therefore, must operate continuously for days in the hot hold of the ship and at times amidst the splashing of water.

Two direct-current Diehl motors with special heat-radiating, water-tight enclosing covers are used for this purpose. The continuous duty rating of these enclosed motors is 50 H.P., 110 volts, 360 to 475 R.P.M.; the normal open rating being 150 H.P. Protection against motor failure due to dropped armatures and oil-soaked commutators and windings, is obtained by supporting the shafts on SKF marked self-aligning ball bearings mounted in sealed housings.

Their use for this exacting service and on the 29 Diehl motors used for general ventilation, is typical of the wide adaptability of ball bearings.

THE SKAYEF BALL BEARING COMPANY

Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

875

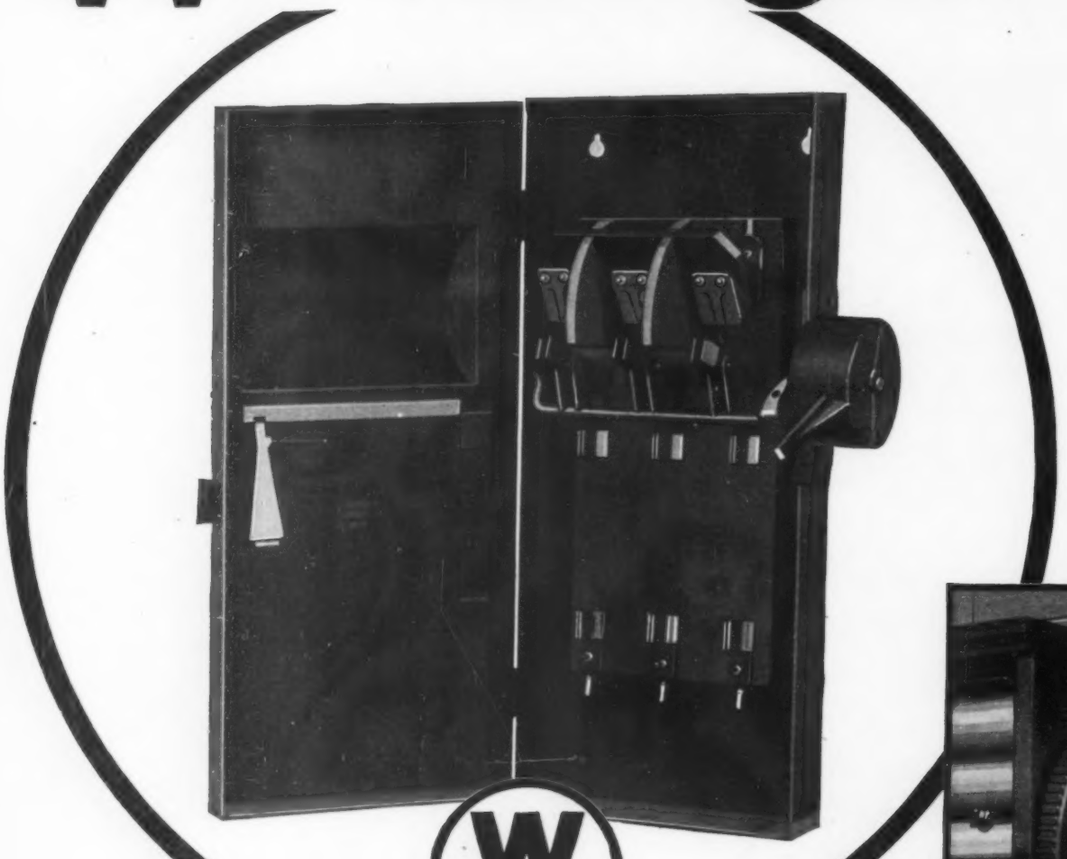
Normal View *Deflected View*

BALL BEARINGS

The Highest Expression of the Bearing Principle

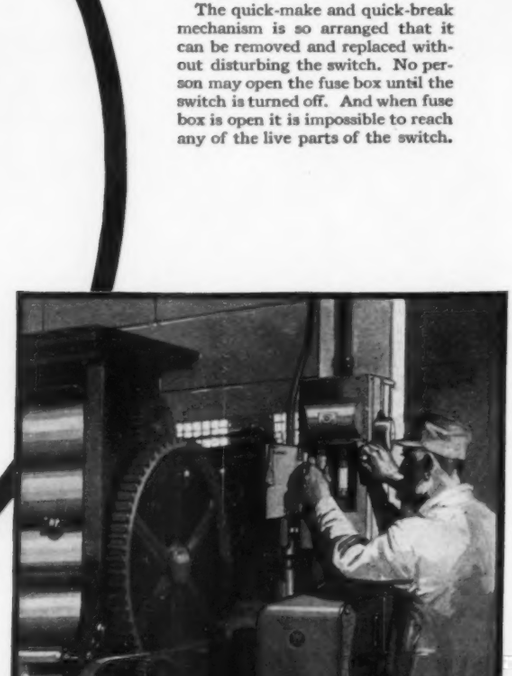
THE SCIENTIFIC AMERICAN, January, 1923. Volume 128, Number 1. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Westinghouse



The type W. K. 55 switches are of very rugged construction with quick-make and quick-break action to withstand the most severe service in industrial plants. Their capacity and arcing arrangements are sufficient to enable the switch to break the locked current of alternating current motors having full load current rating equal to that of the switch.

The quick-make and quick-break mechanism is so arranged that it can be removed and replaced without disturbing the switch. No person may open the fuse box until the switch is turned off. And when fuse box is open it is impossible to reach any of the live parts of the switch.



This illustrates an application of the W. K. 55 used as a disconnecting switch on the live side of a Westinghouse motor starter in a typical mill installation.

Protection!

We are making it possible for manufacturers to get switches that offer complete protection to motors as well as to operators.

This sounds like a rather simple thing—but if you will ask anyone who has tried to find switches, or motor starters, that would fulfill these requirements, you may be surprised to learn that such things have been really scarce.

The Westinghouse line of full-safety (meaning just that) switches and motor-starters is an interesting one, and is unique in its completeness, as well as being remarkably efficient in its operating features.

The fundamental characteristic of this line is, that it is difficult, and usually impossible, for even ignorant and careless operators to come into contact with any live parts of the switch.

In addition to this, these switches are rugged, long lived and the best engineering practice has been followed in their designs.

The most interesting thing of all is that they cost very little more than ordinary switches which do not possess their advantages. And the Westinghouse mark is on them!

Type W. K. 10 motor starters, suitable for motors up to 2 h. p. are furnished in 2 and 3 pole for protection of single phase and three phase motors.

Type W. K. 20 motor starters, for motors up to 5 h. p. are supplied in 2, 3 and 4 poles for single phase, three phase and two phase motors respectively.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
Offices in all Principal Cities · *Representatives Everywhere*

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With the Editors

THE first issue of the new year! The achievements and events of 1922 are now completed and all lined up so that we can review them in retrospect in the editorial pages of this issue, just as we have reviewed other years for the past score of years or more. In surveying the achievements and events of the past twelvemonth it is our practice to go through page after page of the SCIENTIFIC AMERICAN published during that period, jotting down the things of outstanding importance. It is surprising how much is crowded into one of these modern years; indeed, time was, not so long ago, when a quarter as much type would have sufficed to review the progress of the preceding three hundred and sixty-five days. Today, time moves fast. Event follows event; achievement follows achievement; invention follows invention; discovery follows discovery; improvement follows improvement, in rapid, even bewildering, manner. The older fields of science are constantly expanding. Already specialized occupations are being split up into still more specialized occupations, so that the specialist of today becomes the all-round man of tomorrow, in his chosen field. We stand before the coming year with awed expectancy—not unlike the first nighters before the curtain of the theatrical season's newest play. Many things will happen in 1923; old fields are going to be worked far more thoroughly; new fields are going to be opened up. What an interesting period to be living in!

NOT satisfied with the task of chronicling the great happenings and achievements in the world of science—and that is a great enough task, to be sure—the SCIENTIFIC AMERICAN has gone in for some original scientific work of its own. The December issue told you of the decision to undertake the scientific investigation of psychic phenomena at first hand. Since then, things have been moving rather rapidly. We have accepted Sir Arthur Conan Doyle's challenge to investigate the subject at first hand, instead of quoting authorities and well-known investigators at second, third and even fourth hand. The leading newspapers of the country have offered us their utmost collaboration, to the end that we may have our investigation brought to the attention of the mediums throughout the land. Already we are assured of good mediums. They are to work with us and aid us to sift psychic manifestations down to their very bottom. Correspondence has been pouring into our editorial rooms; our editor in charge of the psychic investigation and functioning as secretary in direct cooperation with the judges, has a big job before him. To all indications we shall learn some highly interesting facts regarding a baffling subject. Meanwhile, your attention is directed to the preliminary announcement and the names of the judges on pages 6 and 7, and on page 57, Sir Arthur Conan Doyle's answer to our letter in which we announced the acceptance of his challenge. Our February issue will, in all probability, have news of vital importance. It may be that we shall tell something of the special apparatus that will be used in our sittings; perhaps we shall have held one or more sittings by then and will have the reports for you. At any rate, we can look forward to a steady flow of psychic material from now on—and psychic material at first hand.

REMEMBER, our psychic investigation is your affair as well as ours. We want your suggestions, your experiences, and your keen interest. Perhaps among your acquaintances there is a medium or a person possessing psychic powers which have stood your critical judgment. If so, do not hesitate to tell us about that person or medium, and please be sure to call our investigation to his or her attention. Renown and fame mean nothing so far as mediums are concerned; the little girl who has been entertaining her relatives and friends with psychic demonstrations may be the very medium who will aid us most in unravelling the mystery. Let us make this investigation as far-reaching as possible, so that the final verdict may stand the acid test of public opinion.

INSTEAD of scattering various archaeological items throughout our issues, we have deemed it advisable to group them together in an occasional two-page spread, such as will be found on pages 26 and 27 of this issue, under the title, "The Archaeologist's Note Book." This feature will appear in every third or fourth issue, while more important archaeological subjects will be treated at length in the customary manner.

DESPITE the large volume of manuscripts and photographs which come to our desks in the regular course of events, the SCIENTIFIC AMERICAN editors often find it necessary to sally forth in quest of some definite information or article for our family of readers. So recently we motored down to the home of a very busy man by the name of Henry Norris Russell, best known as Professor Russell of Princeton University, and America's leading astronomer. For a long time we had been endeavoring to obtain a series of articles from Professor Russell on the wonders of the skies—the kind of articles which amaze us and make us realize how insignificant, after all, is this little earth of ours and how much more insignificant is man in the great scheme of the universe. We knew Professor Russell to be a very, very busy man, with his duties at Princeton University and his numerous astronomical activities. In fact, we have always appreciated what it meant for Professor Russell to find the necessary time each month to write the "Heavens" page which appears in every issue of this journal. To make a long story short, we went down to Princeton, spent the better part of a day with Professor Russell, explained what we wanted, discussed the various features with him, and finally left with his consent to write the series at the first opportunity. Somehow or other Professor Russell has found time to write the first article of the series. It will appear in our February issue. It, and its successors, we hasten to add, will not displace the regular monthly contribution from Professor Russell.

FOR many years we gave book reviews which amounted to little more than a mention of the title, author and publisher; and we thus reviewed all books sent to us which by any stretch of the imagination could be regarded as in our field. We have always begrudged this space, and we have finally decided to review only the books of real importance, and to review them in a more worth while style—one which shall really tell our readers something about them. These reviews will ordinarily be gathered into a single article noticing several related books.

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GMC Trucks Last Longer

Sturdier Construction, Finer Materials and Rigid Accuracy Increase Their Years of Usefulness

Years of enduring and reliable performance are built into GMC trucks by the advanced and exclusive improvements that they contain and by the wealth of surplus strength that has been put into every part.

Years of successful truck manufacture have proved the need of certain essentials to the continuous and unfailing performance which GMC trucks invariably give.

Such exclusive features as the GMC two-Range Transmission, providing a perfect series of speeds for every use with no increase in engine size—removable cylinder walls, pressure lubrication—all are directly responsible for decreasing wear and increasing performance ability.

Radius rods, insuring perfect brake action at all times,—bearings or bushings at every point of wear in engine and chassis—extra-large brake drums and oversized springs, which are requisite to a longer life of truck usefulness, are found in GMC trucks.

Moreover, these factors of safety are insured further by the use of the finest materials and by the rigid limits of accuracy to which each part must be fashioned.

No accurate forecast can be made of the length of life of GMC trucks. With reasonable care they will last indefinitely.

GENERAL MOTORS TRUCK COMPANY—*Pontiac, Michigan*
Division of General Motors Corporation

General Motors Trucks

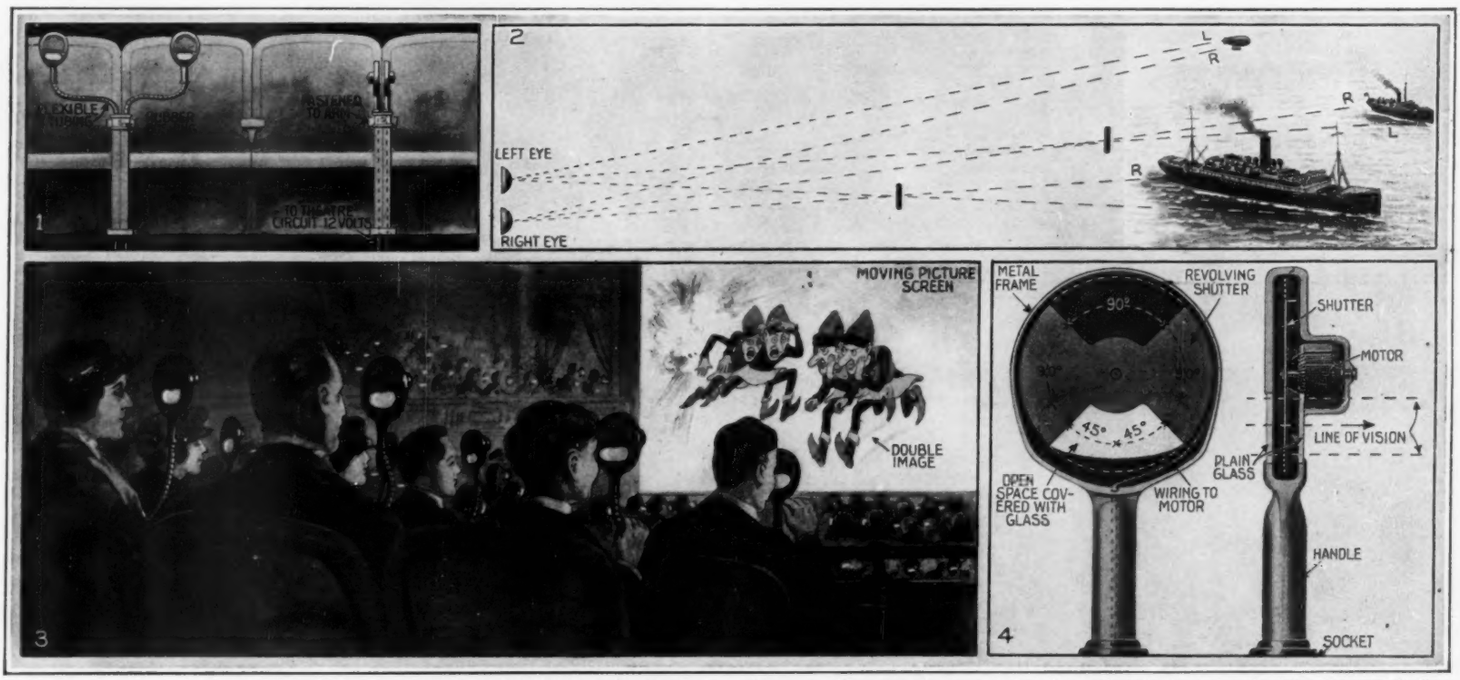
GMC

SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JANUARY, 1923



1.—Front view of a row of theater seats, showing how a teleview is installed for each person in the audience. 2.—Diagrammatic representation of the principles of stereoscopic vision as present in the human eye. The lines of vision from the left and right eyes to objects large or small, near or distant, lie at different angles and intersect at different distances from the eye. It is this effect which enables us to judge distances and sizes, which we cannot do with one-eyed vision, and to get the effect of looking through a third dimension, in spite of the fact that the eye throws its image upon a single plane in the retina. 3.—How the audience views the double-imaged screen pictures with individual televiews. 4.—Constructional features of the teleview device

Stereoscopic vision and how it is reproduced by purely mechanical means on the motion picture screen

Motion Pictures in Three Dimensions

MANY attempts have been made during the past twenty-five years to produce stereoscopic motion pictures—pictures that have a third dimension, depth, as well as width and height. The latest attempt is in the form of a simple electrical device without lenses or prisms, through which each member of an audience views the screen pictures. This little device, which forms part of an elaborate synchronized system of electric drive, causes what is otherwise a meaningless, confused double image on the screen, to become a beautiful stereoscopic picture with solid, living actors and real rounded scenery.

This new stereoscopic motion picture is known as the Teleview. Two negatives are made at one time by means of a camera which has two lenses, mounted 2⅝ inches apart, or the normal distance between the average person's eyes. The camera operates in much the same fashion as would two standard motion picture cameras driven together and in perfect unison. The two negatives are printed on to two positive films of standard size and perforation. If either of these positive films is run through a standard projector, it will give the usual flat picture. Run together by means of two projectors, placed side by side, they produce a blur, as shown in one of our sketches.

When the pictures are to be shown with stereoscopic effect, both films are run simultaneously through double projectors which are placed in such a way as to throw the two pictures on the screen, one over the other, so as to make what is practically one picture. As the two pictures were taken from slightly different points of view, they are not exactly the same and, therefore, with the result that the combined picture is not sharp but represents rather the impression of a double-exposed photograph.

Now then, each spectator looks at the picture through his individual instrument which is fastened on a flexible bracket to the arm of each chair in the theater, and can be shifted to any comfortable position. Like an adjustable telephone bracket, it stays wherever put. The little device, which is shown in another sketch, consists of an aluminum casing in which is an exceedingly small electric motor. This motor, which is only 1¾ inches in diameter, has neither brushes nor sliding contacts, and yet it has all the properties of a self-starting synchronous motor of the three-phase alternating-current type. On the shaft of this motor is a very light aluminum plate of about the thickness of a sheet of paper, which spins continually at a high rate of speed—about 1500 r. p. m. This plate has a general shape like a motion picture shutter, and owing to the peculiar properties of the motor which drives it, it turns in exact step with the shutter of the projection machines which are throwing pictures on the screen. A single alternator supplies the same current to all the driving motors in the theater and those in the projection booth, so that the entire system is in step.

The device mentioned has a large hole covered with plate glass. The spectator, looking through this miniature window, sees the picture first with one eye, and then with the other, in such rapid succession that he is unconscious of the process, owing to the fact that the revolving shutter is constantly passing across his field of vision. The longest period of time through which either eye can see the picture on the screen without interruption is 196th second. The prolongation of the spectator's vision carries two steady impressions of pictures in the two eyes, these pictures being slightly different. Had the spectator looked at the original scene he would have had a different picture in each eye corresponding to the two images on the screen. Therefore, due to the revolving shutter, he sees one clear picture in each eye and these combined together produce the effect of a single, rounded, solid-looking picture. The screen, as such, appears to vanish, while the characters in the drama move forward through the air of the theater to within close range.

Having no lenses or prisms, the little device through which the stereoscopic pictures are viewed has no effect on the vision except when looking at the screen. The audience can gaze about the theater with perfect freedom. This is quite natural because the eyes are merely looking through ordinary glass which is put in the instrument solely for the purpose of preventing the audience from putting their fingers into the mechanism.

All in all, this system solves the technical difficulties heretofore standing in the way of stereoscopic motion pictures. Needless to say, the equipment involved is quite elaborate and expensive, and it is a question whether the average theater would install it for the purpose of obtaining stereoscopic motion pictures. Still, the pictures are truly remarkable and perhaps worthy the additional expense, in special instances. The present "back lighting" effects employed in motion picture work give an approximation of relief which is pleasing.

Our Psychic Investigation

Its Scope, Conditions and Procedure, as Far as They Can Be Laid Down

By J. Malcolm Bird, for the SCIENTIFIC AMERICAN and the Committee

WILLIAM McDOUGALL, D. Sc., formerly of Oxford and the British Society for Psychical Research, now occupies the chair of Psychology at Harvard, and the Presidency of the American Society for Psychical Research. He is the author, among other works, of "Social Psychology," the leading American collegiate text in this subject.

DANIEL FROST COMSTOCK, Ph.D., has recently retired from the Faculty of the Massachusetts Institute of Technology, with which he had been connected since 1904, to devote his whole time to his commercial practice and the development of his laboratory and his inventions. He is a member of the Advisory Scientific Council of the Society for Psychical Research.

WALTER FRANKLIN PRINCE, Ph.D., educated for the ministry and pastor of numerous churches, gravitated, through the psychotherapeutic work undertaken at St. Mark's-Church in New York, into psychical research. He is now Principal Research Officer for the American S. P. R., in charge of its permanent headquarters and its scientific and investigational work.

OUR DECEMBER number carried the bald announcement of our offer, repeated on this page, to pay $2500 to the first mediums producing certain phenomena under our supervision. We must now define the phenomena contemplated, the conditions under which seances will be held and the awards made, and other points. It is not imagined that we shall have covered every ambiguous point which may arise, however; so we must reserve the right to lay down any further conditions that may become necessary. Such conditions will ordinarily supplement rather than supersede the present ones; but if the present statement turns out to be seriously deficient in any respect we must be privileged to make it good. The spirit of the pronouncement here made, however, will not be modified by future specific requirements.

The Formalities of Entry

Mediums may compete for either or both of our awards; but no single phenomenon will receive both awards. Those desiring to compete must make formal application to the writer, as secretary of the committee of judges and administrative officer in charge.

In the Einstein contest, many inquiries which should have gone to the writer as Einstein Editor were addressed to one or other of the judges. We therefore state explicitly that in the present case the secretary's functions will be discharged by the secretary. The judges will be urged to ignore all letters or calls in connection with the committee's business.

The writer should be addressed at the SCIENTIFIC AMERICAN office in New York. The demands upon his time are such that he can see mediums or others interested in the psychic investigation only by appointment.

Entries will remain open until December 31, 1924, unless one or both of the awards be won earlier. This date refers to receipt in this office. Seances will be continued as long as may be necessary to dispose of all entries duly received.

All entries must state in which class the medium proposes to compete.

The degree to which serious consideration of a frivolous application would encroach upon the time of the committee and of other mediums makes it proper to rule out trifling entries. We therefor feel justified in requiring each entrant to show that he has held seances at which, in the opinion of those present, results were obtained. This will work no hardship, since the contest will run long enough to enable a "new" medium to establish his reputation in time to enter. Seances cited for qualification may be private or public, but must be well attested. No medium's record will be questioned further than to establish that he has performed with success; and the genuineness of a properly attested mediumship will not be attacked.

Procedure, apparatus and personnel vary so largely according to the phenomena to be investigated that each entrant in the general class will be required to state roughly the character of the manifestations which he designs to produce. There is no intent of holding him to the production of all these, or of barring phenomena which he has not forecast. The statement is merely for the convenience of the committee and of the medium as well, since it enables the preliminary work to be done beforehand, rather than in the initial seances. There will be no prejudice against any medium for divergence between his forecast and his performance; it is not contemplated to produce psychic phenomena on fixed schedule.

Entries will be listed in the order received. Entrants will be given every opportunity to meet all conditions and to give all necessary seances, in the listed order; and they will not be deprived of their precedence for minor failures to meet engagements. Repeated procrastination by the medium in meeting the desires and dates of the committee, however, will result in his losing his place on the list or, in extreme cases, in his disqualification. The committee must be the final judge of what constitutes repeated procrastination, and of what provides a reasonable penalty.

The Seances and the Award

The committee may have under way, simultaneously, series of seances with several mediums. If one medium produces results which might entitle him to the award, those who have a prior place will be given opportunity to complete their sittings and to win the award through priority; and the judges shall have discretion to deal with such a case on its merits.

All mediums will be required to give a preliminary sitting or sittings before a sub-committee, ordinarily in New York, but when more convenient for all concerned, in Boston. Against an unfavorable report by the sub-committee there shall be no appeal; but such report will not be made without giving the medium a hearing in defence. In the event that the sub-committee's report is favorable or indeterminate, further sittings will be arranged before the full committee. This body will under no circumstances assume the obligation to meet elsewhere than in New York.

THE SCIENTIFIC AMERICAN will pay $2500 to the first person who produces a psychic photograph under its test conditions herewith defined, and to the full satisfaction of its Committee of Judges named herewith.

The SCIENTIFIC AMERICAN will pay $2500 to the first person who, under its test conditions herewith defined and to the satisfaction of its Judges herein named, produces an objective psychic manifestation of physical character as herewith defined, and of such sort that permanent instrumental record may be made of its occurrence.

The Committee of Judges shall consist of Dr. William McDougall, Dr. Daniel F. Comstock, Dr. Walter Franklin Prince, Dr. Hereward Carrington, and Mr. Harry Houdini. In the event of the death or disability of any Judge, a temporary or permanent substitute will be named.

Entry must be made on or before December 31, 1924, to J. Malcolm Bird, Secretary to the Committee, at the SCIENTIFIC AMERICAN office, 233 Broadway, New York.

Either award will be made on unanimous vote of the Judges, or on a four-to-one division. Seances with any medium shall terminate and all his claims to the award shall be vacated upon rejection of his mediumship by formal vote of the Committee.

All the conditions governing entrance, the holding of seances, etc., which are laid down in the accompanying article are part of this offer.

Either award will be made on unanimous vote of the judges, or on a four-to-one division in the medium's favor. Neither award will be made on a three-to-two division; we regard the issue as too important and too controversial to be "settled" by any such narrow margin. Where we employ the expression "the opinion of the judges" or its equivalent, it is to be interpreted in this sense.

The medium will not be held in sub-committee indefinitely. If, after a reasonable number of sittings, the sub-committee has no definite conclusion, it will so report and further procedure will be before the full committee. Here more latitude must be given the judges in the event that they are in doubt. The committee, no more than the medium, can go on sitting indefinitely; but the committee will not report on evidence that seems to it inconclusive. If the medium's only protection here lies in the personnel of the committee, he will be expected to recognize that this guarantee is an effective one. Seances with a given medium will ordinarily continue until the committee awards him the prize or on formal vote rejects his claims.

It is not necessary that the medium satisfy the judges as to the cause of his phenomena, provided he satisfies them that this cause is not a normal one. Our main object in this undertaking is, of course, the hope that, if genuine manifestations are obtained, we may get some indication of their cause. In every case we shall attack this aspect of the matter, as justification for the time and money spent. But if phenomena are produced which the judges find to be within the scope of the contest and of genuine objective character the award will be made. This supplements the assurance of the previous paragraph, that an outrageous number of sittings will not be demanded. If, however, a medium has clearly won the award after a small number of sittings, he may be required to give a reasonable number of additional sittings in the endeavor to secure more data regarding cause and *modus operandi*.

The Judges

The committee of judges has not been picked at random, by shaking distinguished names out of a hat or out of "Who's Who." Each member is selected because of the contribution which he will make and which none of the other members duplicates. Drs. Prince and Carrington are our experienced psychic researchers; their respective experiences lie largely in different directions, so that they supplement one another

admirably in the special knowledge which they will bring.

The presence of Houdini will serve as a guarantee to the public that none of the tricks of his trade have been practiced upon the committee. At the same time, if his fame in another field were not greater, he too might be introduced as an experienced psychic researcher. He is keenly interested and has sat with many mediums. Some of these, to be sure, he has exposed in fraud; but he is eager to believe, and his long pursuit of the subject has always been in search of things worthy of his belief. Against him there cannot be urged the customary objections to the presence in the seance room of persons whose admitted business is to guard against fraud.

A psychologist of repute must be on our committee. The name that occurs before all others is that of Dr. McDougall; and in finding him willing to overlook the distance between Cambridge and New York we are more fortunate than we had dared hope. There must be a physicist of the modern school, skilled in the design and the use of special apparatus; and here Dr. Comstock's name and willingness to serve stand on the same basis as Dr. McDougall's. Were a psychologist and a physicist chosen at random, even though from the front ranks of these professions, they would not necessarily be competent to investigate psychic phenomena. That Drs. McDougall and Comstock are thoroughly experienced in this field and entirely open-minded is sufficiently indicated by their prominence in the Society for Psychical Research.

In the event of the death, the temporary or permanent disability or the withdrawal of any of the members of the committee, the SCIENTIFIC AMERICAN will fill the vacancy, naming some one calculated to bring to the committee what his predecessor brought, so far as this is possible. Such emergency membership may be temporary or permanent.

The keen interest of the individual judges will bring them to the committee's sittings, at considerable inconvenience. At the same time, a five-man body cannot go on indefinitely without absences. We make no definite statement regarding a quorum, giving merely the assurance that the committee will not sit without adequate personnel.

Dr. McDougall has designated Dr. Gardner Murphy to sit in his place when he is absent. Dr. Murphy is a lecturer on psychology at Columbia and Harvard, going back and forth each week between New York and Boston. He will thus be in admirable position to serve as a sort of liaison officer between the Boston and the New York members of the committee. At Harvard, and again in the Society for Psychical Research, he is not merely a colleague but actually a close associate of Dr. McDougall.

Alternates to Houdini must necessarily be, like himself, professional magicians. On account of the numerous engagements which such gentlemen have with the public, and the distances to which these take them, Houdini has felt it advisable to select, from among his co-professionals, two alternates: Messrs. Servias LeRoy and Eugene Powell. The names in question require no introduction to those acquainted with this profession.

Drs. Comstock, Prince and Carrington have not specifically named alternates. They may do so later, or may leave it to us to see that the committee does not suffer from their absences. This matter of providing alternates loses some of its urgency in view of the fact that the committee will at all times invite the attendance in the seance room, or the aid outside the seances, of any persons who may seem in a position to give assistance in the work. No extended notice of the presence or the identity of such persons can be given, but their number and identity will be discussed with the medium in advance of each seance. Extended notice will be given of any change in the voting membership of the committee.

As the accompanying text aims to make clear, we are undertaking an investigation, not of mediums but of psychic phenomena. We are anxious that this investigation shall be looked upon as a cooperative one, not only by our mediums but by all our readers. We cannot naturally throw our seances open to the public, but short of this we are anxious to do everything in our power to get aid and cooperation from all quarters. In particular, if any of our readers know of mediums who produce physical phenomena of the sort outlined in the text herewith, we should be grateful for names and addresses, or for any persuasion which may be employed to get the mediums themselves to compete for our awards. And if any person feels inclined to charge us with undue credulity toward mediums, or with prejudice against them, we can only refer such critics to our December issue, in which our reasons for going into this investigation are given more fully than we have space to repeat.
—THE EDITOR.

The Committee and the Medium

Our committee is to investigate phenomena primarily, and mediums only as this becomes necessary, secondarily. The committee is not going to be blind to fraud, should fraud be attempted; but it is not going to regard its mediums as potential cheats. So far as the medium makes it possible to do this, we shall treat him as a cooperating agent in our investigation. His good faith is in all cases to be assumed; we consider that he may properly regard this as one of the conditions governing his participation.

At the same time, the medium must heed our position. When we investigate a wonderful new carburetor, our story would be of no value unless we were able to assure our readers that all the fuel used in the test came out of the one, measured, supply. We must therefore conduct a search for hidden tanks and hidden pipes, and we must search as thoroughly as though we expected to find them. In our psychic investigations we are in the same position. We cannot report that the seance seemed a success but the medium would not permit an examination of the possibilities of fraud, any more than we can say that the inventor of the carburetor would not allow us to examine the car for hidden gasoline supplies.

We are purposely leaving the conditions surrounding the seances as open as we can. We wish to impose only those restrictions which are absolutely essential to gain serious attention for our findings. The medium will be requested to lay down whatever conditions he feels to be necessary for his own protection and for the production of phenomena; and whatever further conditions he regards as advantageous but not necessary. These conditions will be met in so far as they do not interfere with proper observation and investigation. Where there is a difference between the medium's desires and those of the judges, every effort will be made to find middle ground satisfactory to both. The committee, however, cannot in any case recede beyond the minimum conditions which in its opinion insure proper observations; the production of results which we cannot guarantee is of no more interest or value than a total failure, through too severe restrictions, to produce anything at all.

Precise definition of what constitutes a psychic phenomenon is not easy. After consultation with the individual judges, it has seemed advisable to fall back upon a negative definition. The accumulated experience of the race enables us to say, under given conditions and through the operation of known agencies, what may and what may not be expected. A psychic phenomenon is then something which may not in this way be expected; something which, if it occurs, forces us to make new and special hypothesis; something which can be accounted for on no basis of accepted scientific theory. If we were investigating specifically the existence of disembodied spirits, or of electrical fields pertaining to the human personality, we could with better precision define the effects of such spirits or of such fields. But we are investigating a thing whose nature we do not know and may not even learn. The definition by exclusion seems the only way to separate the phenomena which we seek from those which we do not.

Psychic Photographs

The procedure here varies widely as between different mediums. The committee does not wish to embarrass any medium and will lay down no rules covering the manner of producing these photographs. Plates may be exposed or merely "controlled," and in any way which does not prevent adequate observation by the committee. As a matter of principle, the committee will be altogether averse to having plates taken out of its possession for "control" or other purposes. We will not, however, state categorically that no conditions could be devised under which this would be permitted.

Believers in psychic photography are aware that fraudulent operators have practiced substitution; unbelievers hold that all results are obtained in this way. The committee and its mediums must be protected against any claim that results obtained may be thus explained. Accordingly the committee will supply all apparatus and materials used by the medium. At any time or in any place where he is working with the committee's materials, the medium's possession of material or apparatus other than that so supplied will be *prima facie* evidence of fraud and will result in disqualification. The committee will go to any length necessary to protect the medium against false disqualification, and will even permit the premises to be searched in the medium's behalf and all apparatus found thereon to be inventoried; but the committee reserves the right to use secret identifying marks on plates or other apparatus, in addition to any marks known to the medium.

In the ordinary course of photography, numerous streaks and blurs may appear, accidentally or otherwise, as a result of manipulation of lights, objects, chemicals, etc. There must be border-line cases where it is not easy to say whether a mark is of this character or possesses pictorial form. That this problem may be a difficult one is indicated by the controversy into which Conan Doyle recently got himself over just this question—whether certain marks were fog or faces. Our investigation must lead to definite results or none at all. Hence

(Continued on page 61)

HOUDINI

is so very well known in connection with his escape specialties that some of us may have overlooked his standing as a master of the more conventional sides of the magician's profession. At the same time he is deeply interested in psychic phenomena. He has wide experience in seance work, as well as in the detection of fraudulent mediumship.

HEREWARD CARRINGTON, Ph.D.,

is widely known for his psychic investigations, and for his many technical and semi-popular books in this field. He was one of the committee that so exhaustively investigated Palladino's mediumship; and on more than one occasion he has gone to Europe as the more or less formal representative of American psychic science.

J. MALCOLM BIRD,

who will act as Permanent Secretary to the Committee, is known to our readers through numerous articles. Coming to our staff from the Department of Mathematics at Columbia, he is our versatile member, attending to the things that fall in no other editor's particular field. His most notable work has been in connection with the Einstein contest.

Inventor vs. Forger—II

The Present Status of the War Between the Check Raiser and the Check Protector

By Edward H. Smith

ONE NIGHT in Philadelphia a well-known check raiser named Albert Bell stole a whole pouch of mail from the Broad Street station, concealed it under his big overcoat and walked away. He opened all the letters in the privacy of his room, extracted all the checks, raised every one of them to a larger amount, forged the endorsements of the payees on the back, wrote his own endorsement underneath and deposited these raised and fraudulently endorsed checks in several banks where he had opened accounts. The banks collected the checks and Bell drew out the money in cash. The firms which had issued the checks knew nothing of the fraud until weeks later, when they came to check up their balances or when their creditors began writing in to ask what had delayed payments. By that time Bell was nowhere to be found, but he was apprehended later and sent to prison.

This case summarizes the whole new technique in outline. How were such crimes to be prevented? Inventors, weary of inks and patent papers, came forward with machines designed to print checks in such a manner that no man might raise or change them. The mechanical check protector had arrived in the field. It was the dawn of a new day.

Everyone today is familiar with the mechanical check protector, for millions have been sold in this country and hundreds of thousands are in use every day. Probably half of all the checks uttered in the land are written with such machines and it is certain that nearly all large paper of this kind is so prepared. The average business man feels that his check is not safe without a mechanically imposed guard of some sort.

These mechanisms are of several kinds, one type having superseded the other at intervals in the last thirty years. Each new device has come forward as an improvement on the older varieties, and business men, eager to take advantage of everything that made them more secure in their bank accounts, have bought whatever the latest ingenuity and technical knowledge provided. Inventors in great numbers have been occupied in the devising and making of these patent facilities—to what ultimate end we shall see.

When, in the late 80's or early 90's of the last century, the first check machines appeared on the market, bankers and business men threw up their hats, opened their mouths in cheers and proclaimed in no uncertain terms that the pestiferous check raiser had been stopped dead in his tracks. The little device which elicited all this faith and fervor sold by the thousands and hundreds of thousands. Hardly a bank but had one or more on its shelves. None but the most conservative or the least prosperous business houses could resist the persuasions of this charming patent.

This earliest mechanical check protector was what is technically called a perforator. It punched the amount for which any check was written through the paper in small holes or perforations. Such machines are still used in the banks for canceling paid checks and in some business houses for marking office postage stamps. When such a machine has been used any figure or letter on a check appears outlined in these tiny round cuttings, from which paper discs have been punched by the apparatus.

Here was a thing that met the eye of reason with fair and square conviction. Surely, thought the bankers and business men, a check into which the amount had been cut could never be raised. It was true that engraved, water-marked and lithographed checks had not foiled the cunning forger, that chemical inks were not what had been hoped and that check manipulation was on the increase. But here was the end. How could one change a check whose amount had been cut out and the cuttings thrown away?

The victory seemed to rest with law and business at last. And if there were any men of that day who doubted the completeness and decisiveness of the triumph, I have not encountered them. They have not raised their voices to cry "I told you so." As a matter of fact, American commerce decided that the check raiser was a dead dog and went about its affairs with a light heart and with full confidence in the perforated check.

But there was a genius among the commanders of the enemy. His name was Charles Becker and he stands, by general agreement, as the most expert check raiser and forger in our history. "King of the forgers" was a title bestowed on him by other crooks and the detectives who ran him to earth at last. Becker, a German by descent, was a New York papermaker and lithographer. He was also a printer, electrotyper and engraver. Finally, he was a painter and water colorist of no mean talent. With all these gifts he combined a shrewd, ingenious intelligence, a good knowledge of banking methods and a large acquaintance among criminals. He had been the center of one of the old forgery gangs and had enjoyed an international career, extending his activities as far as Constantinople. Also he had been in prison a time or two and had there been thoroughly finished in underworld education.

When signature forgery was slowly abandoned and check raising came to the fore, Becker changed with the times. He was ideally equipped for the new work, for he was by education, trade and talent fitted to do the technical work of raising. He knew what was to be known of papers, inks, erasers, bleaches, acids, tints, watermarks, lithographs, color blocks and all the rest. Late in his career I saw him take a check which a detective had torn in twain, go to his laboratory with it and reappear next morning with the thing so perfectly mended as to defy detection under an ordinary magnifying glass. All efforts to tear it again in the same place failed. It tore always at a fresh point.

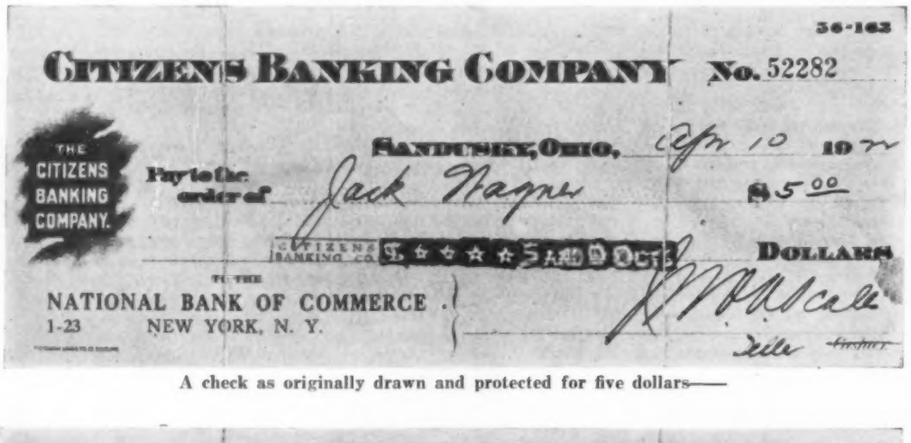
I refer to Becker and his feats to show what the modern check alterer is capable of and what kind of problem he presents. There are men alive among Becker's successors who can do all he did and more. The check expert of today is a technician of the first rank.

Late in 1895 Becker and three other men went out to San Francisco to work a check fraud. They had been active in other parts of the country and decided to try the California banks for a change. The master forger's accomplices on this foray were James Creegan, his veteran middleman, and Joseph McCluskey and Frank Seaver, putters-down. Seaver opened an account in the Nevada Bank of San Francisco, where he drew out and redeposited money for some little time, in order to establish himself as a customer and business man. Having done this to his satisfaction, Seaver went out to the Bank of Woodland at Woodland, Cal., and there bought a draft for $12, drawn on the Crocker-Woolworth Bank of San Francisco. This draft Seaver turned over to Creegan, who delivered it to Becker. The master scratcher went to work, painted over the printed portions of the checks and the authentic signatures with paraffin, dipped the entire check into a bleach, which removed the inked figures, except those protected by the paraffin, and had in hand a plain white signed draft of the Woodland Bank, with its signatures intact, the written amount blotted out and the tint gone.

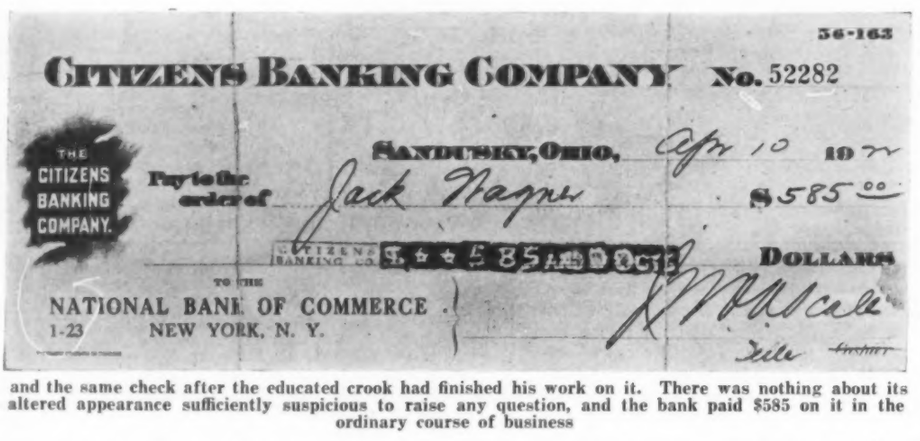
To retint the draft was no difficult matter. Becker had done it often before. Neither was there any difficulty about resurfacing the paper and certainly none about filling in the inked amount of the check to suit the fancy. But—the Bank of Woodland had adopted the perforator check machine and used it on this draft. The amount, $12, was stamped through the check in small holes, and not once but twice. No doubt the banker had felt, as other men did, that his draft was out of the raiser's reach. Becker was to teach a lesson.

He procured a check-perforating machine of the same make as that used by the Woodland Bank and check paper like that in the draft. With the perforator he now cut out a pile of the little round paper disks. Placing the draft on a flat piece of glass, he used glue, sizing, paper pulp and the little disks to fill in the perforations of the check and hold the filling in place. To stop up several hundred small punctures in such manner as to deceive the eye was a patient and precise task, but Becker made no fuss over it. In a few hours the little disks were firmly held in place. The main part of his work was done.

Becker then restored the tint and design on the check, ironed it, touched up the surface here and there with the same materials used by paper manufacturers, took a banker's ink and wrote upon the draft the tidy



A check as originally drawn and protected for five dollars——



and the same check after the educated crook had finished his work on it. There was nothing about its altered appearance sufficiently suspicious to raise any question, and the bank paid $585 on it in the ordinary course of business

sum, $22,000. Next he took the perforating machine, placed the draft in it, set it at $22,000 and twice restamped or repunched the paper in the customary places. His twelve-dollar draft had been converted into one calling for twenty-two thousands.

This draft was delivered to Seaver, who deposited it with the Nevada Bank. A few days later he called, asked for a settlement of his account, drew out the $22,000 and his other balance in gold, retained his share, delivered the balance to Creegan and called it a month's work.

All the members of the gang were trailed after long and intricate work by the Pinkertons. The putters-down confessed and implicated Creegan. Through him Becker also was convicted and both the principals were sentenced to life imprisonment by the California courts. On appeal, however, the verdict was reversed and at the retrial Becker pleaded guilty. He served seven years and was released to do no more check raising. The detectives and bankers' associations got hold of him and persuaded him to use his great talents for honest purposes. He died trying to work out a really indelible ink, much of which he had sold to bankers with a covert smile.

So the first of the mechanical check protectors had been decisively and dramatically beaten. The Becker case and the $22,000 draft were matters of acute interest in their day and the whole business received extensive publicity. Other inventors were promptly in the field with other check protectors. Three general types of these mechanisms have come into use since the perforators were beaten. In their order they were the corrugators or crinklers, the printers and double printers, and the so-called impregnators.

The corrugators were devices which roughened and chewed the paper of the check over the amount line, as that part of the check is called which indicates the sum to be paid. The less complicated sorts simply stamped their crinkled design over an amount line previously written in ink or on the typewriter. Later came machines which printed the amount line and, at the same time, did the job of corrugating. The theory was that the paper of the check would be so disturbed by this roughening that erasures and raising would be impossible. But roughened checks presented less formidable obstacles than those from the perforators. The check raiser simply laid them on a sheet of glass, smoothed down the roughnesses with his thumb nail or a smooth paper knife, erased the original amount with a rubber, a spun glass eraser or the common ink removers known to every bookkeeper. Then he wrote in whatever figures pleased his opulent fancy, put the check back into the crinkler, reroughened it and cashed it. It was too easy. The corrugators slowly but surely joined the procession of failures and wound up in the dust bins of office buildings.

The next creature of the inventive brain devoted to check protection was the printer. This machine, which is still in fairly common use, simply printed the amount of the check on its surface in supposedly indelible ink. Sometimes the figure appeared thus:

$ One thousand seven hundred and fifty $

Again the machines did not print the exact amount but a limiting figure; thus, *Not over One Hundred Dollars Not over.*

Later on came various improvements of this type of machine. Some printed the amount in figures, in the belief that numerals were harder to juggle than letters. The still further developed printers stamped the amount on both sides of the check, with an inking pad working from above and below. This was done to prevent friction erasures.

But all these excellent ideas amounted to one and the same thing in the end. They made it difficult for the office man and amateur to raise checks, but they had no terrors whatever for the expert. If he couldn't erase by friction he could with bleaches and acids. If he was unable to bleach one part of the check without leaving a telltale stain, he bleached the whole thing and then retinted. It was all a fine comedy to him. His takings from banks and depositors continued to mount.

The impregnators are the most recent of check machine inventions. Much as has been claimed for them, I am unable to find anything that is either novel or convincing in their makeup. In principle they have gone back to two ideas already exploded and discarded from the experimentation of check experts. Readers of my preceding article will recall the discussion of an ink which was supposed to perform a chemical reaction with salts in the paper and thereby become indelible. Add this old notion to the crinkler machine, just mentioned, and you have the main principles of the impregnator. This machine is said to chew into the fiber of the paper and inject an acid proof ink, merely another way of stating the same propositions, it seems to me. However, I do not wish to assume the position of denying to these devices such virtues as may be theirs. They undoubtedly restrain the casual check alterer in some instances. For the expert they have no terrors whatsoever.

It must, however, be remembered that today's check raising problem is one in which the professional criminal forms only one part of the dilemma. The office man and amateur are quite as important and from some points of view even more vital. Check raising is essentially the crime of the beginner. Probably its lure misleads more inexperienced young and old men than any misdeed except embezzlement. Hundreds of cases come up every year in which both young office clerks and trusted employees have been tempted or driven by adversity to raising checks and pocketing the cash. The maker of check protectors has, perhaps, the right to claim that his machine does a good deal of valuable work in restraining this class of offenders. But there is another side to this picture, too.

For a good many years the salesmen of the check protector concerns have gone about all the cities of the country giving demonstrations in check raising. Every one of these salesmen can beat every type of machine but his own—or so he says. And he is always ready to demonstrate his prowess against the machine in use by the prospective customer.

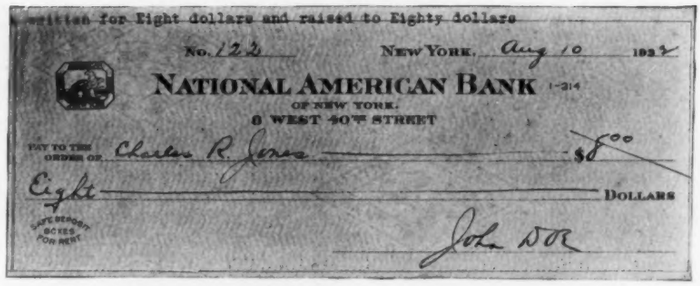
The machine salesman walks into the office of Brown, Black & Green, business men. He asks for the office manager, says that he understands the firm uses the Little Terror check machine and puts on a pitying smile as he recounts the instances in which that mechanism has been beat for large amounts. The office manager listens. He is incredulous. Only six months before another salesman told him the Little Terror was invincible and caused him to throw away his Checkster Supreme. It can't be true; this awful thing the new salesman is saying.

"Write me a nice little check on your old Terror machine and I'll show you," says the salesman.

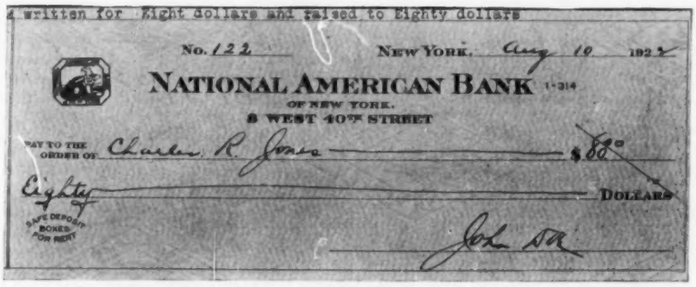
He digs into his portfolio, brings out a few simple tools, a couple of bottles of colorless fluid, an eraser or two and a sheet of glass. The office manager, who has meantime become excitedly interested himself, summons his assistants. Others gather about. The check is written in the office machine. Perhaps some wagers are laid to make the thing a sporting proposition.

The salesman flourishes the check in the air, touches it with a little of his fluid, erases a bit, puts on a drop of fresh tint with a camel's hair brush, dries the

(Continued on page 67)

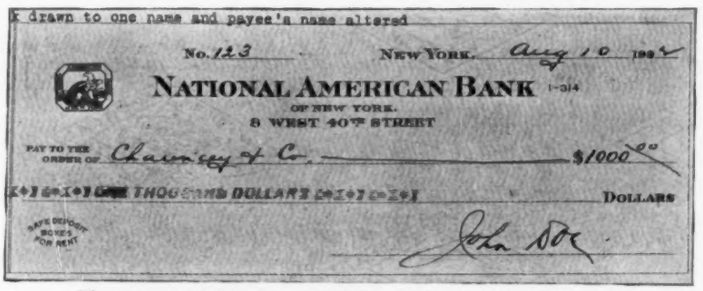


This check was written for eight dollars, without any great attempt at protection;

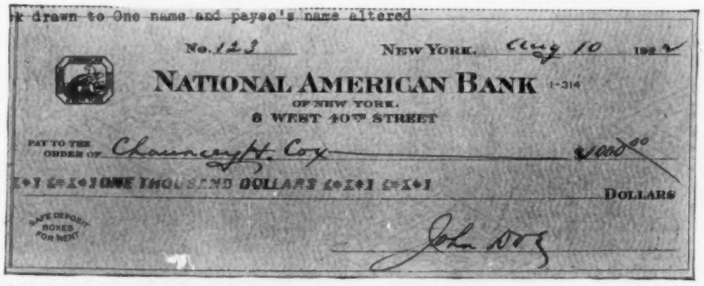


but with a few touches of the pen in the hand of a check raiser, the amount becomes eighty dollars

LAST month Mr. Smith told of the early stages in the battle between the banks and the forgers; and he brought the tale down to the point where forgery was going out, and alteration coming in in its stead. In the present, and concluding, instalment he brings the story down to date, explaining the genesis of the mechanical check-protector and showing just what it will and what it will not do. Too great exactitude of detail naturally cannot be employed in telling of the procedure of check alteration; we are not running a school of crime. We would emphasize, however, that Mr. Smith's account of the way in which specially prepared paper, or specially prepared portions of the surface of a check, can be unmade and made over again, is in no sense exaggerated; no matter how the paper may be deformed in the writing of the check, it may be built up again and worked upon in any way necessary for the forger's aims, to give a result which cannot be detected by any method which a bank can afford, as a matter of routine, to adopt for all checks. A check is put in benzine after it has been paid and the drawer has repudiated it—not before. That is the problem which the inventor has to solve.—THE EDITOR.



The amount of this thousand-dollar check was left unchanged;


drawn to One name and payee's name altered
No. 123
NEW YORK, Aug 10 192
NATIONAL AMERICAN BANK
OF NEW YORK.
8 WEST 40TH STREET
PAY TO THE ORDER OF Chauncey H. Cox
$1000 00
DOLLARS
SAFE DEPOSIT BOXES FOR RENT

but the payee's name was altered. This is the latest wrinkle, and in practically every case the altered check is paid without question

Rapid Transit on a Moving Belt

AMONG the popular attractions at the Chicago World's Fair in 1893, was a moving platform built on a pier extended into the lake, which carried many thousands of passengers without a mishap. At the Paris Exposition of 1900 there was built a moving platform on a much more ambitious scale. It made the circuit of the grounds and had a total length of 10,900 feet. Operated continuously throughout the Exposition, it carried over 7,000,000 passengers without a serious accident. Today, the chief engineer of the Rapid Transit Commission in this city recommends the installation, in a subway extending from Third Avenue to Eighth Avenue, below Forty-second Street, of an endless moving platform with loops at each end.

The growth of New York during the past decade has been at a rate so enormous that the residents of New York have felt more and more the pinch of the situation, and the consequent difficulty of passing from one part of the city to the other. This difficulty has become so threatening that Commissioner Enright has thrown up his hands and states his inability properly to meet the situation. No longer is it possible to pass by automobile from one part of the city to the other with any comfort; and the subways are crowded to overflowing. The traffic in New York, as most people know, is longitudinal, that is, it extends from north to south, and most of the subways run in that direction. The problem of double-decking the streets has been seriously considered, but that has many inherent objections besides the one of enormous expense. The present city administration has added to the difficulty of the situation by discouraging the surface lines, some of which ran laterally across the city.

The question has got to be faced of how to transfer the passengers in an easterly and westerly direction, and the plan which is put forward in our accompanying illustration shows how this problem may be attacked. In the general plan it is not entirely new; in detail, however, there are a number of features which are essentially a new creation, and as the problem has come up at this time we present it as now shaped for present consideration.

The moving platform has such a large passenger capacity, and is so admirably adapted to preventing congestion and moving great crowds of people, that its failure to be adopted, long ago, in congested city centers is difficult to explain. From the point of view both of the engineer and of the traffic expert it is an ideal system, and the only conceivable hinderance to its adoption is its novelty and a certain streak of conservatism that runs in most of us.

The principle upon which this method of transportation is based has long been known, and has been applied very successfully in industry, in the economical and rapid transportation of large quantities of material by what is known as the belt or continuous conveyor. We see an application of the principle also in the escalator, to which the moving platform is broadly similar, with the difference that in the escalator there is only one moving element, and in the moving platform there are two or more running parallel, and side by side.

Each element of the moving platform is made up of short units coupled together to form an unbroken floor stretch extending the full length of the transportation route. In the system proposed by the Rapid Transit Commission there are three parallel floors. The first of these, adjoining the stationary station platform, moves at a speed of three miles per hour; the next at six miles per hour, and the third at nine miles per hour. The last of these is wider than the other two, and is provided with cross seats, each accommodating two people.

The stations are generally similar to those of any subway, and after depositing his fare at the turnstile the passenger walks across to the moving platform and, facing the direction which it is traveling, steps on the first platform, then on the second, and finally gains his seat on the third platform, where he travels at the rate of nine miles per hour. It is not anticipated that there will be any difficulty to passengers in boarding or leaving the "train." It did not take long for the public, including children and elderly people, to find out how to handle themselves upon an escalator.

In our issue of May 13, 1905, we gave an illustration of the mechanism of the moving platform as then designed. By comparison with that it will be seen, from the improved form shown in the drawing facing this page, that important changes have been made all tending to greater economy of cost and operation. In the earlier design there was a deep pit extending 6 feet 6 inches below the moving platform, in which was installed a series of wheels driven by electric motors. The rotation of these wheels served to carry the platform forward. As now designed, the pit below the floor is only 14 inches deep instead of 6 feet, 6 inches, and each section of the platform is carried upon its four attached trolley wheels. An entirely new system of electric traction has been designed, which is extremely simple, and has the great advantage of being so compact as to call for only a little over a foot of clearance between the platform and the bottom of the subway. As patents are pending upon certain details of this device, we shall have to reserve its description until a later issue. The advantages of the moving platform are many and obvious.

CAPACITY: The seating capacity is necessarily enormous, and is due to the continuous character of the service. A "drop in a bucket," if continued for 24 hours will total a gallon and a half; and the 8.8 passengers per second who may be given seats on the platform moving at nine miles per hour, passengers being seated two abreast, will amount to 31,680 per hour. It would require ten-car Interborough trains running under 50 seconds headway to supply this number of seats, or 72 ten-car trains per hour.

SPEED: Although the moving platform speed is less than the schedule speed of local subway trains, we must remember that the subway passenger has to wait for his train, and the average time in waiting for a local is about one-half of the time involved between two successive trains. Within certain limits, the platform is a quicker means of transportation than a local subway train.

NO CONGESTION: Since passengers, as soon as they reach a station, step on the platform and are carried away, there is no waiting, and, consequently, no congestion either on the station platform or on the moving platform.

ECONOMY OF POWER: The larger part of the electrical energy used on a local subway train is expended in starting and stopping trains; and not in their propulsion. There is no starting and stopping on a moving platform. Furthermore, the weight of the moving platform per seat is very much less than the weight per seat of the subway passenger car. There will also be economy in the use of power, due to the elimination of gears, and the free use of roller bearings.

Chief Engineer Turner is careful to show that the only possible drawback of the platform are the conditions of travel which would occur when the passenger travel is light. Thus, in train service the number of trains may be varied according to the number of passengers, whereas, in the moving platform the entire mass must be kept in movement even during the periods of light traffic. Hence, the economy in cost of power would vary according to the density of traffic. On the whole he believes it is safe to assume that with traffic such as that at Forty-second Street, sufficient to warrant the construction of a moving platform route, the cost of power would be very much below that in Interborough train service. Also, because of the mechanical simplicity of the moving platform, the cost of maintenance should compare favorably with that in any hitherto used system of passenger transportation.

A STATION AT EVERY STREET: Not the least of the many advantages of the new system will be its accessibility. There would be a station at every street crossing, and, in the case of long blocks, an intermediate station. Consequently, passengers would be saved the walk of several blocks which is necessary under any existing subway service; and, as we have pointed out, immediately he had passed the turnstile he would be seated and traveling a uniform speed of nine miles per hour.

The President's Plea for a Merchant Marine

THE special message of President Harding to Congress on the Merchant Marine must carry conviction, surely, to everyone who brushes aside prejudice and party politics and approaches this great subject with an open and candid mind. His very able statement of the problem derives its strength from its simplicity, its logical presentation of the facts, and its telling appeal to reason and judgment. Whether purposely or not, the question of the disposal of our wartime fleet has been beclouded by appeals to prejudice, by sophistical reasoning, and by the frequent statement of those half-truths which are often more vicious and misleading than actual falsehood. Briefly stated, the facts of the situation as reviewed by the President are these:

During the war we built very rapidly, and, as he says, "poorly, often very poorly," a fleet aggregating approximately 13,300,000 gross tons. Excluding the wooden fleet which has been scrapped, the total is now about 12,500,000 tons. More than half of this tonnage is owned by the Government, and approximately 2,250,000 tons are under Government operation in one form or another. In the year before the present administration took office, the Treasury was paying out about $16,000,000 per month to keep this fleet going; but "by enlisting capable business management and experienced operating directors," the draft on the Treasury has been reduced to $4,000,000 per month, or a total of $50,000,000 per year. The cost of the construction of our wartime fleet is given by the President as $3,000,000,000.

Such is the situation today; and three alternatives are open to the American people. The first is to pass the shipping bill, thereby placing these Government ships under private management and control and paying to the various shipping companies a sum which would vary from a minimum of $20,000,000 to a maximum of $30,000,000 a year, in order to make good any losses which may be incurred during the fierce competition which is certain to be encountered. The second alternative is either to sell our ships abroad or scrap them at home, with the accompanying "surrender of our aspirations and confession of our impotence to the world in general, and our humiliation before the competing world in particular." As regards the last alternative, it must be remembered that in view of the present surplusage of shipping in the world, the great falling off of trade, and the drop in freights, such ships as might be sold would fetch only a nominal price.

The President puts in a powerful plea for what he calls the *constructive* as against the *obstructive* and the *destructive* policies. In defence of the subsidy, a term which he does not use, preferring to speak of the sums paid out of the Treasury as "aids" to shipping, he reminds us that it is not a question of adding new Treasury burdens to maintain our shipping, since we are carrying these burdens now. "I am not asking your authorization of a new and added draft on the public treasury. I am appealing for a program to diminish the burden we are already bearing." In proof of this he points to the estimated cost, under the shipping bill, of $25,000,000 per year, as against the present cost of $50,000,000, and then he passes on to remind the country that the $50,000,000 does not cover all the current losses to the public treasury, since we are wearing out our ships without any provision for replacement and we are charging nothing against our capital account.

After a strong appeal to the country to set aside "geographical, occupational, professional, or partisan objections," and a call to "lofty statesmanship," which would aim at national rather than local benefit, the President reminds us that we have aided industry through tariffs, the railways by land grants; have helped in the construction of roads and waterways; have aided reclamation, loaned seed grains for agriculture, and expended millions in investigations for the national good. If Congress has aided (or subsidized, if you will) the means of transportation on land, why should it hesitate to give similar assistance to transportation by sea?

In one of his remarkable series of letters, Ambassador Page writes: "If we cultivate the manly qualities, and throw off cranks, and read our own history and be true to our traditions and blood, and get some political vigor; then, if we emancipate ourselves from the isolation theory and from the landlubber theory—get into the world, build ships, ships, ships, and run them to the ends of the sea, we can dominate the world in trade and in political thought."

Finally, if the United States should ever be involved in another great war, it will be a war in which the rapid transportation of our armies by sea will be involved. In the recent World War we had no adequate fleet to furnish the needed transports. During the effort to build one, we lost invaluable time and spent $3,000,000,000. If the next war should find us without a fleet of transports, our folly may well involve the United States in a great national disaster.

For fully a quarter of a century the SCIENTIFIC AMERICAN has been a consistent advocate of Federal assistance to shipping. We urged it when our merchant marine was represented by a mere handful of ships; and today we plead the same cause, but with all the added emphasis which comes from the fact that we now possess the second greatest merchant fleet in the world.

Moving platform for 42nd St., New York, with capacity of 32,000 seated passengers per hour—the equivalent of 72 ten-car express trains

APPLYING BELT-CONVEYOR PRINCIPLE TO RAPID TRANSIT

Our Point of View

REVIEW OF THE YEAR 1922

Civil Engineering

THE MOST notable constructive work of the civil engineer during 1922 has been in the field of hydraulic engineering, in providing water supply for our cities, irrigation for our public lands, and hydroelectric power for public and private service. San Francisco engineers are pushing forward their masterful work for providing San Francisco and the surrounding district with a daily supply of 400,000,000 gallons of water, and in the East the Board of Water Supply engineers at New York City are completing the Catskill water supply scheme by the construction of the Schoharie reservoir, and an 18-mile tunnel through the mountain, for leading the Schoharie water into the existing Ashokan reservoir. The two combined will give New York a supply of 500,000,000 gallons per day. The Caribou hydroelectric plant, possessing in its 15,000-horsepower Pelton wheel the largest of this type ever constructed, has been completed; and satisfactory progress is being made in building the various irrigation dams of the Reclamation Service. The problem of what to do with the Muscle Shoal dam is yet unsolved, although there is a growing feeling throughout the country that the well-known offer of Henry Ford should be accepted, thereby putting this great investment of the United States Government to useful service. The two outstanding problems in inland water transportation are the New York State Barge Canal, which is completed, and the St. Lawrence Canal, which still exists only upon paper. A notable event in the development of the Barge Canal was the opening of the 2,000,000-bushel grain elevator at the New York end of the canal. The most daring project now occupying the attention of western engineers is the control of the Colorado River by a series of great rock-fill dams of unprecedented dimensions. As a sample of this proposal we mention the Glen Canyon dam, 500 feet in height, and the other suggested dam at Boulder Canyon, with a proposed height of 600 feet. It is a question only of time and capital when this work will be inaugurated and carried through. During the year work has been actively pushed either in preliminary work or in the actual construction of several great bridges. Among the proposals are those for the crossing of the Hudson River, of San Francisco Bay, and of the Detroit River: San Francisco Bay by a series of cantilevers of 2000 feet span, the Detroit River by a suspension bridge of 1803 feet span, and the Hudson River by a chain suspension bridge of 3240 feet span, supporting a double floor 235 feet in width. The foundations for the Camden bridge, of 1750 feet span, are being put down without any serious difficulty. Because of the great diameter of over 30 feet of the Hudson vehicular tunnel and its length, the recent commencement of the driving of the tunnels was an event of outstanding importance. Other notable tunnel work was the completion of a second Simplon tunnel, and the electrification of the St. Gothard line and tunnel. There has been some discussion during the year of the possibility of the supply of lockage water for the Panama Canal proving insufficient to meet the increased traffic of the future. Bunau-Varilla has suggested that the best solution would be to cut the canal to sea-level, making what he has called "The Straits of Panama." The meteorological experts at the canal believe that for many years to come there will be no shortage of water; moreover, by using the higher reaches of the Chagres River the water supply may be greatly enlarged.

Aeronautics

It is probable that to the average American citizen the outstanding events for 1922 in aeronautics are the phenomenal speeds achieved in the annual race for the Pulitzer trophy, and the equally astonishing results obtained in the successful development of the art of gliding or soaring flight. The winner of the Pulitzer trophy in 1921, flying a Curtiss Navy biplane, covered a course of 153.59 miles, at an average speed of 176.7 miles an hour. This year the winner, in a Curtiss Army, thin-wing biplane, brought the world record for speed to this country, the winner making an average of 205.8 miles per hour. After the meet, pilot Maughan flew his winning machine over a straight-away course of one kilometer at a speed of 248.5 miles per hour, as recorded and accepted by the United States Army. Later, General Mitchell, with the same machine, made a straight-away flight at a speed of 224.05 miles per hour, this last being accepted as the record by the International body. After a careful study of soaring flight, the Germans built special gliding machines, the most successful of which remained in the air for three hours and ten minutes. Toward the close of the year, in the first English competition, Maneyrolle, on a Peyret Tandem monoplane, remained in the air for three hours, twenty-one minutes and seven seconds. There has been a marked tendency toward the monoplane type, and the use of metal is being regarded with increasing favor. Some makers are using duralumin exclusively for their machines, and others make use of a combination of that metal with a steel alloy of high elastic limit and breaking strength. Cautiously, builders are beginning to make use of thin high-grade alloy steel as a wing covering, and ply-wood is also being applied for the same purpose. Brennan has built a costly helicopter in the effort to win the prize of $250,000 offered in Great Britain for a perfected helicopter, and in this country Berliner has been experimenting with his new helicopter at College Park, Md. It has flown horizontally for a short distance at a speed of 20 miles per hour. It looks as though there is a long road to travel before the perfected machine of this type makes its appearance. Commercial aviation, as represented by the carriage of light freight and passengers, in spite of the praiseworthy courage and activity on the part of its promoters, is making but slow progress. Fundamental to the establishment of airplane travel in the confidence of the public is the sympathetic action of the government, shown first, in the enactment of greatly needed legislation for the control of the new art, and, second, in financial assistance sufficient to put the new venture firmly upon its feet. That travel through the air is not inherently and necessarily dangerous, where a skilled personnel is given a serious job to do, is proved beyond all question: first, in civil flying, by the success of a well-known flying boat service between New York, Key West and Florida, which on these and other courses has flown over 1,000,000 passenger-miles, and carried over 15,000 passengers without a single mishap; second, by the government air-mail service on its New York-San Francisco daily route, on which from July 16, 1921, to September 7, 1922, 2,000,000 miles were flown without a fatal accident, during which service, out of every 100 trips scheduled, 94.39 were finished on schedule time—a truly magnificent performance. This review of the year would not be complete without mention of the organization of the Aeronautical Chamber of Commerce of America, which, if it maintains its record of service of the past year, is bound to prove one of the most helpful agents in the all-around development of aviation in the United States.

Railroads

The railroads of the United States are still recuperating from the effects of the war; but it is encouraging to realize that in the past year a greater advance has been made toward normal conditions than in any of the post-war period. But little new construction has been undertaken. Available funds were applied to the betterments which were so sorely needed, such as the relaying of track and the provision of new rolling stock. The electrification of railroads, thanks to its consistently good results, is being steadily extended, particularly to mountain divisions. The most notable advance in this direction is seen on the Chicago, Milwaukee and St. Paul Railway, which now has 649 miles under electric operation. Improvements in rolling stock are in the direction of larger freight cars, longer trains, and more powerful locomotives. The effort to economize in fuel consumption was shown in the development during the year of two turbine-driven locomotives, one English and the other Swedish. The Swedish locomotive has hauled the same express trains as handled by the standard locomotives, with the astonishing reduction of 50 per cent in the fuel consumption. The action of the Interstate Commerce Commission in calling for the installation of the so-called automatic stop, or its equivalent, on certain congested railroads has an importance second only to the government action which rendered obligatory the air-brake and the automatic coupler. There are some types of automatic train control which, under test, have shown very satisfactory results. The man who equipped an automobile with flanged wheels and ran it on steel tracks probably builded better than he knew; for one of the most significant developments of the past year has been the growth in favor of this idea, and its development in the form of large and powerful cars well adapted to operation on feeder lines to the main railroads. The saving in dead weight, fuel and labor, coupled with the frequency of service, make the success of these cars well assured. In a review of the year mention should be made of the development of the container car for the safe and convenient carriage of express and other valuable freight. The protection against breakage and the general convenience of this system have been demonstrated on several of the leading roads of the country. The railroad world is becoming interested in the question of reducing the dead weight of passenger cars, and frequent attention has been drawn to the articulated train, in which the abutting ends of the passenger cars are carried upon a common truck. By this method there is a reduction in the length of a train and in the deadweight per passenger, with no sacrifice of safety or comfort.

Merchant Marine

The mention of shipping brings immediately to the mind of any thoughtful American the outstanding problem of the upbuilding of our Merchant Marine. The coming of the Armistice found the American people with a great merchant fleet of 12,500,000 tons of really serviceable ships in their possession. The effort of the Shipping Board to operate these ships, either directly or through private firms, has shown that under our present methods, we cannot compete with foreign ships except at a loss. The Subsidy bill proposes to remedy this situation by paying to the operators a sum of money equal to the difference between the cost of American and foreign operation. There are two outstanding arguments in favor of this legislation—first, that it will retain in this country in normal times some $300,000,000 in freights hitherto paid to foreign carriers; and second, that the possession of a large merchant fleet will be a great asset to the Navy in the event of a war involving large maritime operations. The past year has seen the advent to the Port of New York of the "Majestic," the largest ocean steamship ever built. Probably she is the last ship of her type that will be laid down for many a long year to come. The new liners, judging by recent British and American construction, will be vessels of about 20,000 tons, of large combined freight and passenger-carrying capacity, using oil fuel, and capable of a sea-speed of from 16 to 17 knots. Increasingly the heavy-oil motor is becoming a rival of the steam turbine as a substitute for "that good old reliable," known as the reciprocating steam engine. The latest statistics show that of a total of 61,343,000 gross tons of world shipping, 51,653,000 are driven by steam reciprocating engines, 8,149,165 by steam turbines, and 1,540,463 by motors.

Our Point of View

Perhaps the most significant figures are those of the latest classification by Lloyds, from which we learn that in 1918-1919 there were classed 2,633,570 tons of steam reciprocating, 1,051,302 tons of steam turbine, and 75,934 tons of motor-driven shipping. Three years later, in 1922, the figures were 1,420,924 tons reciprocating, 870,037 tons turbine, and 226,552 tons of motor-driven ships. The decline in shipbuilding has continued. Its revival will come only after the eagerly awaited revival of world trade.

Naval and Military

History has shown that the years following immediately upon a great war have been marked by a reaction of the public mind against naval and military expenditures. So active was this spirit after the war of the Revolution, that the war of 1812 found us utterly unprepared both on land and sea. The lesson of preparedness, thus taught for the second time in our history, again fell upon deaf ears; so that the upheaval of the Civil war found the nation as utterly unprepared as at the opening of the two previous wars. We were similarly unprepared for the Spanish war, which was followed, at least so far as the army is concerned, by a period of national indifference and false economy which, in the ten years immediately preceding the World war, seriously affected the navy also. The lesson of the World war is with us today, and the attitude of Congress during the past year shows clearly the need for great watchfulness on the part of the forward-looking people of the United States, if the country is not again to lapse into its historical post-war attitude. The year 1922 will stand out in naval history as having witnessed the most important movement for international understanding, by the mutual reduction of naval armaments, in all the recorded history of the world. The adoption of the 5-5-3 ratio placed the relative strength of the three leading navies upon a permanent, mutually agreed basis. The benefit of the Limitation Treaty lies less in the physical economies achieved than it does in the triumph of reason and morality over brute strength. Unfortunately, in limiting battleship strength, the Conference failed to lay down any ratio of cruiser strength. In other words, the nations are free to build this class of ship in any numbers that they may please. The United States has ever been weak in light cruisers, and today, as against the excellent fleets of these vessels possessed by Great Britain and Japan, we have none of a modern type in commission. Ten light cruisers of 7,500 tons will be completed this year; but to balance our fleet we should authorize at once ten additional ships, built up to the limit of 10,000 tons, and having the highest speed and radius of action and the most powerful batteries that can be secured upon that displacement. The spirit of indifference to the navy's needs, to which we have referred above, expressed itself in the effort of certain Congressmen to cut down the enlisted strength to 67,000 men, when the size of the navy as designated by the Limitations Treaty called for at least 110,000. Fortunately, in response to the protest of the country, the measure was defeated, although the total allowed was only 86,000 men. This means that our existing fleet, with the additional ships which are due for completion this year, will be woefully undermanned.

If the navy is in jeopardy from the Pacifists the army is equally so. The Armistice found us with a fine organization, born of the exigencies and developed according to the experiences of a great World war. General Pershing and the General Staff drew up an excellent scheme for maintaining a skeleton organization with a large proportion of officers, the latter being used for purposes of giving annual training to the reserve officers. The scheme aimed to produce and maintain a real national army, consisting of the Regular army, the National Guard and the Organized Reserves. The General Staff, after cutting down this skeleton organization to the lowest possible limit, asked for a minimum of 150,000 men. In spite of this expert advice, the House of Representatives attempted to make a cut to 115,000 men.

Pure Science

The member of the staff in whose province it lies to write under the above caption has, according to his recollection, more than once complained that, as fast as his subjects develop, they are taken out of his keeping and made part of the field of electricity or engineering or some other practical subject. He has protested, in this connection, that every year he has to confine himself more and more to astronomy—that this is the only science that seems to lie permanently in his domain. And now, after casting his eyes back in retrospect of the year 1922, he trembles lest even this refuge be lost to him. Astronomy is fast becoming a very practical and very much applied science.

It is acquiring this status, not so much in its own name, as in the name of the other sciences, which it is rapidly coming to overlap and largely to control. The physicist and the chemist, and through them even the engineer, have been, of recent years, very busy pushing the boundaries of their knowledge back toward the ultimate beginnings of knowledge. And it is now plainly to be seen that, the further they carry this process, the further they go toward dependence upon astronomy for their ultimate facts.

One of the most significant contributions of many years presents an extraordinary case of this linking up of the sciences through astronomy. It started in an investigation of certain peculiarities of the photographic plate. It widened very quickly into an investigation into the properties of light. And it bears fruit in the hypothesis, outlined to our readers at first hand by Dr. Mees in our May issue, that light is not simply and severely a wave motion of the imponderable ether, but is perhaps even as material as Newton believed it to be.

The astronomical tie-up comes partly through the fact that the astronomer it is who has to employ light as his sole observational tool; and partly through the fact that when, in conformance with modern procedure, we reduce the thing to a basis of mathematico-physical formula, we get something very much akin to the Einstein theories—and must then call upon the astronomer to tell us whether what we have fits in with the facts. The eclipse expeditions of September, 1922, then acquire somewhat more significance than if they were a mere repetition of that of 1919. What has been done in other fields in the meantime leads the average scientist with much greater confidence than he would otherwise feel, to anticipate that when the observations made in Australia are reduced to their ultimate findings, they will support the new theories of the nature of things.

The retrospect would not be complete without enumerating a few other items. Little actual scientific progress has been made in the investigation of what goes on inside the atom; but great progress has been made in extending to a larger audience an understanding of the work done here in previous years. The puzzling problems of biological light and of cold light have been brought together theoretically, at least, and in a manner from which it appears that practical results may ultimately flow. The scope of the meteorologist continues to broaden; and if it were possible for him to manufacture, in a day, an adequate body of statistics, he would have no trouble in extending his venue even more rapidly. Much research has been done upon the invisible radiations at the ultra-violet end of the spectrum, and more than one job has been found for these short wave-lengths. The chemist goes on exalting the place which colloids occupy in the chemistry of life and in every branch of technological chemistry as well. The psychologist continues to build up his science and to put it on a basis where hard-headed men of practical affairs feel obliged to take it seriously. Psychic science occupies a larger place in the public consciousness than ever before; and, if we are to credit reports coming from apparently credible sources, physical phenomena of psychic origin and of altogether unheard-of and utterly amazing character have been produced. In this connection we would quote a prediction from our seventy-fifth anniversay number of 1920 if we had the space; but we have not, so we must content ourselves with reminding our readers of what we then said.

Radio Communication

This has been a radio year. The closing months of 1921 saw radio broadcasting introduced on a small scale and more or less as a novelty, and it remained for the first six months of 1922 to give the new art a tremendous impetus. The development, as we now look back, was a sudden, uncontrolled, and, in many ways, mismanaged one, which was bound to call for a painful readjustment. So the story of radio in 1922 is one of a sudden development which became a nation-wide craze, accompanied by the production of radio instruments and parts by companies and individuals on a colossal scale out of all proportion to possible demands; the opening up of broadcasting stations here and there without regard to their usefulness or their destructive possibilities; the inadequate laws and their guardians who were totally unprepared for the overnight appearance of radio broadcasting and who have not yet revised their rules of procedure to take care of a chaotic situation; and finally the public reaction against radio, followed by a renewed and sounder interest in the closing months of the year.

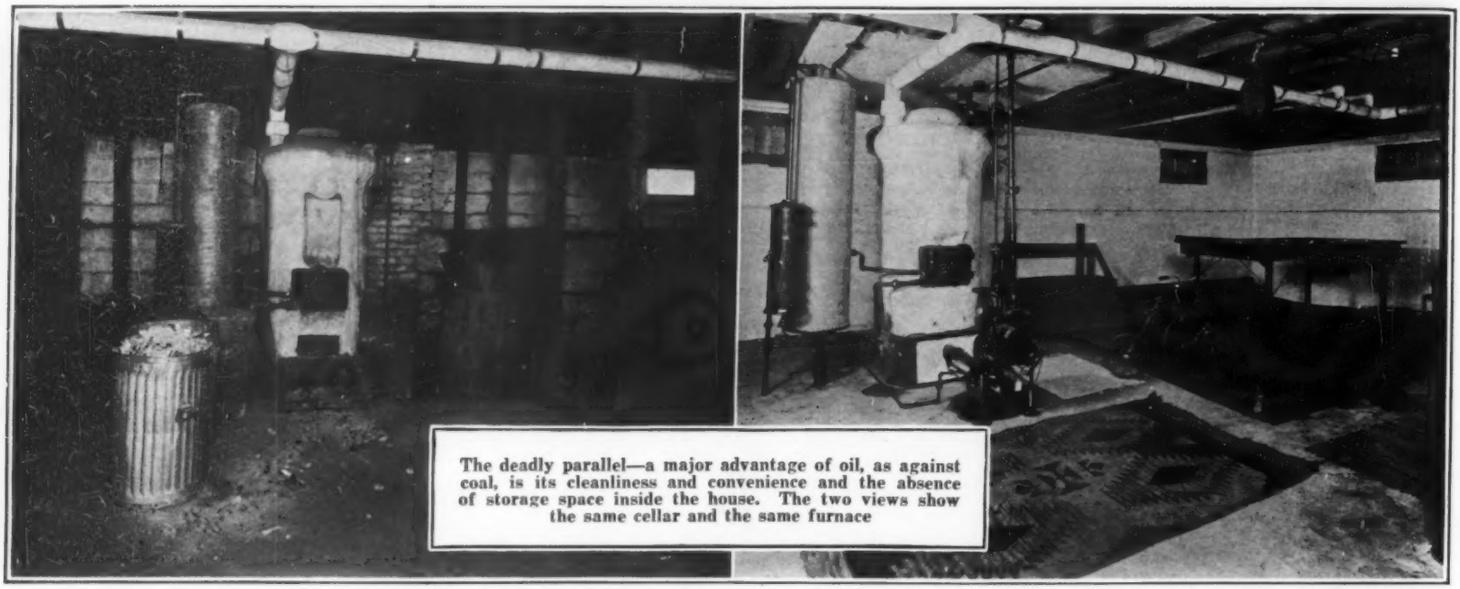
Improvement has followed improvement in radio. This period has given us better receiving apparatus, better loud-speakers, the Armstrong super-regenerative receiver, radio frequency amplification, and many other improvements. Meanwhile the commercial companies and the Governments throughout the world have kept to the task of weaving a virtual carpet of radio lines over the entire world.

Electricity

The progress of electricity both in the laboratory and in the workaday world, has been steadily maintained during the past twelve months. More and more we are convinced that this is the electrical age and that there is virtually no definite limit to what can be accomplished through the various applications of electric current. Indeed, there is a steadily growing belief, backed up by an array of impressive facts, that electricity is at the basis of all matter and even of that mysterious thing called life.

In the laboratory, electricity has figured prominently in recent months. Remarkable results have been obtained with improved forms of vacuum tubes which have other applications aside from radio communication. Several new types of vacuum tubes have been worked out successfully, and it now appears that in time these vacuum tubes, particularly the magnetron, will play an important rôle in the generation and transmission of electricity over long distance lines. Another laboratory achievement has taken the form of high-tension transmission. Electrical engineers have been experimenting with voltages ranging up into the millions, and have learned much about the true character of lightning.

In the field of communication, excluding radio, steady progress is also recorded. Certain improvements now make it possible to handle more cable traffic over existing lines, and we are not apt to see the cables replaced by radio for a long time to come, if ever. The automatic telephone system has been extending its field of operations until it seems probable that the "Hello" girl must in time make place for dial-operated 'phones. The greatest progress has been made in the amplification and relaying of telephone messages and speeches. Public speakers have been addressing larger and larger audiences not only beside them, but also scattered throughout the country, through the long-distance telephone lines, the wonderful amplifiers, and the loud-speaking units now developed for the purpose.



The deadly parallel—a major advantage of oil, as against coal, is its cleanliness and convenience and the absence of storage space inside the house. The two views show the same cellar and the same furnace

Fuel by the Ton or the Gallon?

The Principal Advantages and Disadvantages of the Oil-Burning Furnace for Domestic Use

By Harry A. Mount

THE COAL strike, with resulting scarcity and high prices of fuel, has turned the attention of thousands of persons who had never given the matter serious thought before, to the possibilities in fuel oil. Agencies selling fuel oil and oil-burning equipment have literally been swamped with inquiries, and oil burners in great number have been installed to replace coal as fuel.

Many of those who have been goaded into the purchase of oil-burning equipment will wish, in the light of mature judgment and experience, that they had stuck to coal. But many others will find fuel oil vastly superior for their purposes and we may expect the net result of the present intolerable fuel situation to give great impetus to the use of fuel oil.

Especially is this true of home heating. Already great quantities of fuel oil are used in industry and its field of usefulness is pretty well defined and understood. Those industries which have turned to the use of fuel oil in the present situation have done so not so much because it was cheaper or more economical for them to burn oil, but because coal could not be had. The use of oil for fuel in the home is comparatively new, for it has only been within the last few years that burners which were safe and economical have been developed.

Those who have taken the trouble to investigate the possibilities of fuel oil in home heating have usually found that they have had to revise their ideas to a considerable extent. There are many popular misconceptions about fuel oil, and this is perhaps an opportune time to help clear them up.

In the first place, the term "fuel oil" itself is misleading. "Fuel oil," as applied to house heating, usually means kerosene. In industry, the fuel oil generally used is the black tarry residue from refining processes. "Fuel oil" includes every grade of oil between these extremes, or it may even be the crude petroleum as it comes from the wells. Crude oil is only used for fuel, however, when it is of such low grade (that is, deficient in gasoline and light oils) that it does not pay to refine it. Some of the Mexican oils are of this poor quality, and most of the crude oil used for fuel comes from there. However, only about 10 per cent of the total of fuel oil used is crude, the remainder coming from the refineries.

The amount of fuel oil remaining after the refining processes depends upon the quality of the crude. A high-grade Pennsylvania crude is practically all refined into various products, and there is little or no fuel oil derived from it. Other crudes may yield 50 or 60 per cent fuel oil, while the average yield is about 15 or 20 per cent.

Sometimes this residue is so poor in quality and contains so many impurities that it can only be used profitably in making tar and asphalt products. Other fuel oils contain so much sulfur that the sulfuric acid generated in burning would ruin the heating plant in a short time. Other factors which govern the value of this refinery residue for fuel are its density, heat value, flash point and viscosity.

Because of the very great range of quality in heavy fuel oils, it is practically never advisable to use them unless the amount used is very large, so that the oil can be shipped in large quantities making it profitable for the shipper to insure a uniform product. Small industries and homes, unless there is some unusual and very favorable circumstance, cannot well use this cheaper grade of fuel oil. Indeed, it is practically impossible for the small user to obtain a supply at all, since he would require tank-wagon delivery and cheap fuel oils cannot be handled economically in this way.

It is quite possible, as the use of oil for fuel in homes develops, that the oil companies will supply a lighter and higher grade fuel oil, which will be cheaper than kerosene. Indeed, steps have already been taken in this direction, but at the present time the only fuel oil of uniform quality which the average householder can obtain is kerosene.

Another factor against the use of the cheap heavy grades of fuel oil in the home is the difficulty of handling them and the complication of machinery necessary to burn them. Usually the oil is so heavy that it has to be heated in order to coax it to run through a pipe. A necessary step in all oil-burning processes is to atomize the fuel; and to atomize heavy fuel oil either steam or compressed air under high pressures is required. As a rule these cannot easily be had in a home.

Kerosene, on the other hand, can be atomized by the blast from a small electrically driven blower and it requires no pre-heating. Since most of the successful oil burners of small capacity use a small fan or blower to atomize the fuel, they are practically limited to kerosene or other light oils for fuel.

In industry, where the plant machinery is under constant supervision, the complication of machinery necessary to burn heavy fuel oil is not of serious importance. The usual form of burner is a nozzle to which the oil is pumped. As it issues in a thin stream it is struck at right angles by a blast of air or steam at extremely high velocity. This breaks up the oil into a fine mist and when oxygen is supplied in proper quantity, it burns readily without soot, ash or smoke.

Sometimes the air or steam and the oil are mixed in a mixing chamber within the nozzle and the mixture is spread out in a fan or cone shape by a special spray tip. Super-heated steam is usually preferred to compressed air because the heat of the steam helps to vaporize the oil. But a little calculation will show that a burner of this kind may use a considerable quantity of steam. Where steam is precious, as on ship board, this type of burner has been generally replaced by another type which atomizes the oil by whirling it from the edge of a rapidly revolving disk and carrying the oil mist into the firebox with a blast from a fan or blower.

It will readily be appreciated that such burners cannot be used in a home, where they are expected to function more or less intermittently and with little or no attention. The typical oil burner for home installation consists of a small blower operated by an electric motor and a small pump for forcing the oil through a spray nozzle located in the draft of the blower. There is a pilot light of gas, or an electric spark for igniting the mixture in the furnace. Usually, also, there is some kind of safety device operated by floats in a catch basin, or the weight of the oil in a drip pan, to shut off the driving mechanism and the oil, should the fire accidentally go out. With such an equipment there is practically no fire hazard, as the storage tank is always

AS the winter advances and the difficulty of getting an adequate supply of coal remains about the same, more and more householders turn their thoughts to the use of oil as a source of domestic heat. We do not refer, nor does Mr. Mount in the accompanying article refer, to the single-room kerosene stove. All of us are using this as an emergency measure; all of us understand full well that it is nothing more than this. But what about the conversion of our hot-air or steam or hot-water plants to the use of oil fuel? This is not an emergency measure; it is a permanent substitution of oil for coal in the domestic cellar. This is what Mr. Mount is talking about, and the point is emphasized by the picture at the head of the page, where the same furnace appears, now run with coal and now with oil. It is with the arguments for and against this change that Mr. Mount deals; and he makes it plain that the decision, for or against, is not one to be made lightly or without consideration of numerous factors.—THE EDITOR.

located outside the house. Most of the successful burners also are provided with thermostatic control, to keep the rooms at a constant temperature without attention from the operator.

One type of burner, which has been very successful, dispenses with the electric motors, pumps and all other auxiliary apparatus, using self-generated steam to atomize the oil. The fire-pot is water-jacketed and in operation becomes a small steam-boiler. A float chamber and automatic valve admit water to this boiler as fast as it is used. The oil flows by gravity to a point about two inches below the nozzle, and from this point it is sucked by a venturi tube effect, caused by the issuing steam. Thus the oil pump is got rid of, without danger that someone will forget to turn off the oil and flood the machine. This burner also has a safety device to shut off the steam and oil, should the fire go out. Unlike the blower type, this burner cannot be ignited from a pilot light but first the boiler must be heated with gas or gasoline until steam is generated before the burner will operate. Once lighted, it is automatic in operation and will continue to burn as long as water and oil are supplied. There have been instances where burners of this type have operated continuously throughout an entire heating season without attention or adjustment of any kind.

This type of burner has been operated successfully on crude oil, but because of the difficulty of obtaining a satisfactory fuel supply for household purposes, as cited above, the owner of this burner also is usually restricted to kerosene for fuel. This brings us to the question of when it is economical to use fuel oil to replace coal for home heating.

Coal varies as greatly in fuel value as fuel oil, but for ordinary purposes of calculation it is usually assumed that hard coal contains 11,000 British thermal units of heat per pound, and that kerosene contains 136,000 units per gallon. Assuming that these fuels are burned with equal efficiency, the oil equivalent of coal would be 162 gallons per ton. As a matter of fact, in efficiency of burning, advantage is nearly always with oil. Most users of coal, both industrial and domestic, are very wasteful of fuel. Fires are allowed to get too hot, dampers are not properly regulated, the air supply is too great or too little, fresh fuel is not applied properly, good coal is sifted into the ash pit and thrown away, fuel is unnecessarily wasted in smoke, fires are not banked correctly and in a score of other ways fuel is wasted.

Ordinarily only about 25 per cent of the fuel value in coal is turned into useful heat. Even where particular care is taken the efficiency is usually not over 40 per cent. But in burning fuel oil the conditions are determined in advance by competent engineers and the human element does not enter so largely. Most of the other sources of waste are eliminated so that the usual efficiency for oil burning is 50 or 60 per cent. Engineers find, therefore, that instead of 162 gallons of oil, only 110 or 112 are required to do the work of a ton of hard coal. Based on the later calculation, which is conservative, and with coal at $14 a ton and oil in bulk at 11 cents a gallon (prevailing prices in New York City at this writing) kerosene oil can be burned at a saving over coal of $1.62 per ton. These prices and figures, of course, must be revised to suit individual cases and other communities. In general, whether fuel oil can be burned economically depends on the nearness and nature of the local coal supply and the price of kerosene in the community.

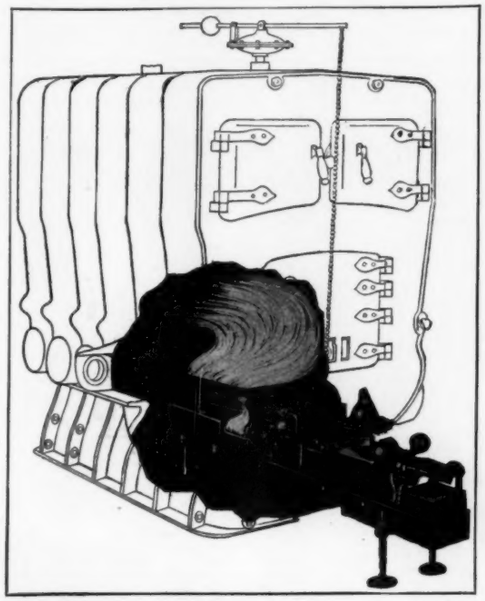
But there are other considerations. The labor of firing the furnace and of removing the ashes is dispensed with. If there is any expenditure for these purposes with coal fuel, it should be subtracted from the cost of the oil. No storage space is required for fuel inside the house, a more uniform temperature can be maintained, and dirt, dust and smoke which are a part of coal burning are done away with. Even if the cost of fuel oil was slightly in excess of coal, these considerations might outweigh the cost.

On the other hand, the first cost of installing the oil burner is high, usually ranging from $350 to $750, depending on the type of burner selected and the capacity and placement of the storage tank. This figure includes the labor cost of installation. The average cost for a seven-room house should be about $500.

Although the normal life of the burner may be estimated by its maker at 15 or 20 years, it would not be advisable to calculate its usefulness at more than five years, because of the general oil situation.

The oil companies discount the statement that our oil supply is nearing its end. They point to the tremendous new fields in Canada, the great potential supply remaining in Russia, the almost untouched oil resources of South America and the Orient, and the always-present possibility that new fields will be discovered.

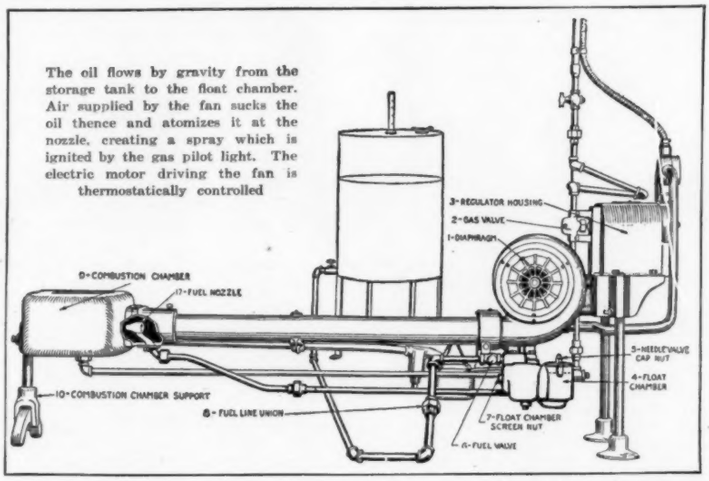
But the fact remains that the oil resources of the United States are pretty well known and that after only about ten years of intensive use, they are already



This burner uses self-generated steam to atomize the oil, and is believed to be the only domestic burner that will handle successfully the heavy fuel oils

on the down grade. Consider, in relation to this fact, that the United States uses about two-thirds of all the oil produced in the entire world. No matter what potential supplies exist outside of the United States, it is almost a certain fact that we shall have to go further and further afield for our oil and the cost of obtaining it will constantly increase.

It is pointed out in this connection that there are enormous quantities of oil to be obtained from our great oil shale deposits. But oil from this source can-


The oil flows by gravity from the storage tank to the float chamber. Air supplied by the fan sucks the oil thence and atomizes it at the nozzle, creating a spray which is ignited by the gas pilot light. The electric motor driving the fan is thermostatically controlled
3-REGULATOR HOUSING
2-GAS VALVE
1-DIAPHRAGM
9-COMBUSTION CHAMBER
11-FUEL NOZZLE
10-COMBUSTION CHAMBER SUPPORT
8-FUEL LINE UNION
5-NEEDLE VALVE CAP NUT
4-FLOAT CHAMBER
7-FLOAT CHAMBER SCREEN NUT
6-FUEL VALVE

Another type of burner, intended for kerosene or other light fuel oil

not compete with that pumped from the ground because the cost of obtaining it is too high. This supply will undoubtedly be tapped as soon as the cost of crude petroleum reaches a level where competition is possible, but when that time comes fuel oil for your furnace will cost a great deal more than at present.

Of course, the cost of coal may mount in proportion, so that even if oil does cost more, it may still be economical to burn it. But our supply of coal is not so limited as our oil resources and a different set of conditions will adjust its price. When our domestic oil supply is reduced to a low point (so our present consumption indicates), we will still have a generous supply of coal which may be had for the digging.

It seems reasonable to believe, therefore, that for another five years it may still be possible for many people to use oil as fuel instead of coal. But during that time we may expect as a certainty a steady increase in the price of oil. Whether it will be economical to burn it for fuel after that is problematical, with the chances against oil fuel.

As to the use of the heavy oils for industrial purposes, that is a different story. As long as gasoline is used in such quantities as at present, there will always be a great volume of refinery residue which probably can be used as fuel with better economy than for any other purpose. Furthermore, there are certain industrial processes which practically require oil. In shipping so much valuable cargo space is saved and the other advantages are so obvious, that we may expect to see an increase in such use of fuel oil, even in the face of rising prices.

And then, there are the requirements of the Navy to be considered. Oil for naval use in modern warfare is almost indispensable, and already the Government has taken steps to conserve part of our domestic supply for this use.

Out of all this, we may reasonably conclude that an estimate of $100 a year for depreciation against the average household installation for oil burning is not excessive. Add this to your former estimate of the cost of oil burning in your home, and balance it against the advantages to be obtained, and you are ready for a final decision.

Prevention of Damage to Highways by Overloaded Trucks

MANY interesting subjects are discussed at the Annual Conference on Weights and Measures which takes place each spring at the Bureau of Standards of the Department of Commerce. Weights and measures officials from all over the country are present, and the papers which they present serve to keep the whole country informed of the progress that is being made in weights and measures matters throughout the United States.

At the last conference held during May, Mr. John N. Mackall, chairman of the Maryland State Roads Commission, delivered a paper upon the subject of "Protection of Highways by Means of Portable Weighing Devices." Mr. Mackall pointed out that the greatest destruction to improved highways is caused by overloaded trucks, and any device which will serve to prevent this undesirable condition is, therefore, important. The State of Maryland has adopted an interesting portable weighing machine which operates on the jack principle and by which the load on the rear axle of any truck can be easily determined. If trucks are found to be overloaded, the driver is required to remove any load in excess of the limit prescribed by law and in addition has to appear in court and tell his story. The methods followed in Maryland have greatly reduced the damage to highways by overloaded trucks, and it is likely that many other States will follow the example of Maryland in this important work.

The Katathermometer

A PRELIMINARY study of the katathermometer made by the Bureau of Mines in connection with its metal-mine dust and ventilation investigations, indicates that the instrument will probably be useful for making routine determinations of comfort conditions in mines, and that it may also prove an important accessory for investigative work on problems in ventilation and kindred subjects in both coal and metal mines, although the instrument should probably be altered somewhat for maximum utility under the varied conditions in the mines of the United States. The katathermometer is an instrument contrived by Dr. Leonard Hill, an eminent English physiologist. Dr. Hill, after exhaustive experiments, concluded that the rate of cooling of the human body was the controlling factor in determining comfort or discomfort, and then set out to make an instrument that would measure this rate of cooling. The resulting instrument — the katathermometer — measures its own rate of cooling when its temperature approximates that of the human body and thus serves as an index of the rate of cooling of the body itself. Its use is outlined in Serial 2355, which may be obtained by addressing the Bureau of Mines, Washington, D. C.

Two Bridges in One—Chicago's Michigan Avenue Bridge

By William A. Mulcahy

Chief Engineer of Construction

THE Michigan Avenue Bridge, Chicago, which was opened to traffic on May 14, 1920, links the North and South Side Boulevard systems on one of the world's finest avenues, lined by some of the most prominent clubs, shops and high-class office buildings, and located in the heart of one of the greatest cities in the universe, is considered the finest and largest bascule bridge in the world. It is a double-leaf, double-deck structure of the bascule type, having four trusses, and each truss supported by a trunnion shaft or axle, upon which the bridge revolves. These trunnion shafts, eight in number, are the largest ever used on a bascule bridge, and vary in size from 24½ inches to 26 inches in diameter and weigh from five to seven tons each.

The bridge is so designed that it can be disconnected along its center line by the removal of numerous bolts, and either the east or west half of the structure can be raised to an open position if it becomes necessary to repair either side. In other words, the bridge as a whole, is made up of two bascule bridges paralleling each other, and either half can be operated independently, without interference with traffic or navigation.

The clear span of bridge from center to center on trunnion shafts is 256 feet. Total length of bridge at upper roadway level is 340 feet. Clear width of channel between piers is 220 feet.

The lower deck is for heavy vehicle traffic and is 20 feet above the river surface, it contains two roadways, each eighteen feet wide, with 14 feet headroom, including provision for street car tracks if it becomes necessary to install them. There are two sidewalks six feet wide on this level.

The upper level which is used exclusively for passenger auto traffic is 37 feet above the river's surface, and contains two roadways 27 feet wide, and two 16-foot sidewalks. The width of the top level is 92 feet over all; the widest structure of bascule type ever built. Creosote wood block is used for paving the upper and lower roadways.

There are in the bridge about 3500 tons of steel, 500 tons of machinery and electrical equipment, 800,000 rivets, and in the tail ends of the bridge, about 4000 tons of counterweight to aid in balancing the structure and eliminate overloading the operating motors.

Flexible yielding barriers will safeguard the public on both levels when the bridge is in open position. The bridge is operated by four 100-horsepower motors, on each side of the river. The electrical control is an interesting feature of construction, and is of a new type called "remote control." It is fool proof as far as human efforts can devise. Other motors of small sizes are used for operating the centerlocks, near locks, pit pumps, etc.

An elaborate lighting system of the upper and lower roadways is provided, including ornamental light poles and various types of clustered lights. There are flaring plazas at each end and stone balustrades, operating towers, stairways, classic sculpture and comfort stations.

The bridge when completed and perfectly balanced can be raised and lowered in about three minutes. This means a big saving of time, and money to both pleasure and heavy traffic vehicles using this bridge, which is on one of the busiest thoroughfares in the world. The south approach to the bridge commencing at Randolph Street is about 1400 feet long and 127½ feet wide, having a roadway 75 feet wide (the old roadway was 38 feet wide) and two sidewalks 25 feet and 27½ feet wide. The north approach ending at Ohio Street is 1100 feet long and 141 feet wide, having a roadway 80 feet in width and two sidewalks each 30½ feet in width. The total length of the lower level roadway is 1900 feet. It is 110 feet wide south of the river and 120 feet wide north of the river with 8 to 10-foot walks.

The steel in the approach and plaza will total about 5000 tons, and the concrete in place about 25,000 yards.

The importance of the lower level street with its connections to intersecting streets, is not realized by many people, but the fact of the matter is that this thoroughfare will be the main artery for heavy vehicle traffic going to and from the largest railway freight terminal in the world which is located just east of the Michigan Avenue Improvement. The proposed South Water Street Improvement will also connect up with this improvement on both the upper and lower levels.

The foundations for the bridge were rather difficult to construct and required two of the largest and deepest cofferdams ever used for a bascule bridge. They are best described to the layman as large watertight boxes, 75 feet by 175 feet, with clay filled puddle walls and heavily braced on the interior to offset the tremendous pressure due to the river. After the water was removed from the interior of the dam and bracings were completed, excavation was started for the main piers and tail pit 40 feet below river level.

From the bottom of these broad excavations for the tail pits and to support these large concrete piers, 18 wells or caissons were sunk some 108 feet below the river to rock and others to unyielding hardpan 90 feet below the river. These concrete caissons and the piers above them support a cross girder on each side of the river weighing 100 tons. These cross girders support the trunnion shafts upon which the bridge revolves.

Considerable difficulty was encountered in this work because of the old water tunnel shaft in the south cofferdam which had to be removed. Also a concrete tunnel of the Chicago Tunnel Company passed through the rear of the south cofferdam 26 feet below the river. It was necessary to place massive watertight bulkheads in the tunnel at both sides of the same and remove 75 feet of this tunnel, which interfered with the bridge piers.

These tunnel bulkheads, 26 feet below the river prevented water from flowing into the tunnel and thereby avoided millions of dollars in damages to property and to buildings in the downtown district which are connected to these tunnels.

All this difficult foundation work was carried on as rapidly as possible, with the delays incident to the country being in a state of war, with embargoes on steel and other materials, and even on coal a part of the time; but despite a continued shortage of labor and numerous delays due to labor trouble, the work was prosecuted night and day, and in the most severe winter weather very little time was lost.

This is considered one of the largest municipal improvements in the country, and in spite of the unsettled conditions of labor, material and railways, remarkable progress was made. Work was started April 13, 1918, and the improvement turned over to the use of the public May 14, 1920. The plans and specifications of this improvement were prepared by the city's engineers with the assistance of Mr. Michael J. Faherty, President, Board of Local Improvements, and the Chicago Plan Commission, and the contract work was done by the Great Lakes Dredge and Dock Company.

The cost of property purchased by the city of Chicago for the improvement was approximately $7,000,000. The cost of construction of the improvement itself amounted to approximately $8,000,000.

Every engineer who has traveled through Europe must have noticed the evident attention which has been paid by European engineers to the architectural treatment of their bridges, which in the majority of cases has been carried out with good judgment and excellent effect. Of late years we have been giving, in the United States, increasing attention to this aspect of the bridge builders' art; and whereas, formerly, the engineer was satisfied if his bridge was economical, stable and adequate to its duty, today the bridge designer aims to make his structure beautiful as well. The Michigan Avenue structure not only solves an urgent traffic problem, but it provides Chicago with a monumental structure of highly artistic merit.

Clear span, 256 feet. Width, 92 feet. Weight of steel, 3500 tons. Balanced by 4000 tons of counterweight. Lower deck for heavy vehicles. Upper deck of autos

Opening the massive Michigan Avenue bascule bridge at Chicago

Doing Two Things at Once

Multiple Consciousness, or Reflex Action of Unaccustomed Range?

By Dr. Alfred Gradenwitz

CAN WE, at a given moment, think of several things at a time? Are we able simultaneously to perform several acts each entailing a certain concentration of our mind? Common experience would seem to answer yes, for we can, while performing some manual work, with perfect ease listen to a conversation or even read a book, and there are many feats of a higher intellectual order, such, *e. g.*, as the achievements of men like Cæsar and Napoleon, whom history credits with the ability of dictating six or more letters at a time, as well as the wonderful performance of chess players capable of conducting 20 or more games simultaneously.

Still, scientists were inclined to think that, so far from being simultaneous, actions such as these followed on one another with rapid alternance. The Medical Society of Metapsychic Research, at Berlin, however, at a recent monthly meeting attended by the present writer, examined the case of a young lady, Miss Thea Alba, who by her ability simultaneously to control several apparently conscious acts, no doubt deserves the attention of scientific workers. Before introducing her to the Society, Dr. C. Bruck had tested Miss Alba both in private and with some other members of the committee.

Apart from having been, throughout her school days, a most intelligent pupil, and from a certain propensity to occasional left-hand writing, Miss Alba until quite recently had not exhibited any abnormal behavior. One day, however, when questioned about an occasional absent-mindedness, she declared in the family circle that her usual habit was always to think of two or three things at a time. In order to test this ability, she was asked to try whether she could write simultaneously (different words) with both hands, whether she was able with one foot to describe a circle and at the same time to write a 3 or an 8, etc. The latter task she mastered spontaneously, the former after half an hour's training. Within six weeks she went through a whole program enabling her to exhibit her unexpected art on the stage. Being a good drawer and pianist, she trained herself to paint and draw with both hands as well as to play the piano with one hand and write or draw with the other. In connection with a medical examination she proved able spontaneously to draw a life-sized portrait with both hands within 20 seconds. Though her face was covered down to the mouth, all parts of the portrait were traced at the right place. Moreover, Miss Alba succeeded in writing simultaneously with three pieces of chalk, one of which she kept in her mouth. Another achievement demonstrated at the meeting of the Medical Society, and which is no less surprising, consists in writing with three pencils or pens at a time, keeping one with the left and two with the right hand (between the second and third and the fourth and fifth fingers respectively). In order to illustrate the independence of the various operations, she will write simultaneously in three languages—English, German and French—and even talk in the meantime. Her left hand always writes backwards, while both hands sometimes in addition place the words upside down.

While the left hand writes one line in reverse, the fingers of the right hand, working in pairs, produce two other lines

Now, Miss Alba's abnormal faculty would seem to consist in *automatizing* one or more operations *within an unusually short time*, often immediately, without any previous training. This also agrees with the fact that she sometimes, when first performing a given operation, being left in the lurch by her automatic impulses, temporarily has to work by turns instead of simultaneously. This theory is borne out as well by what Miss Alba has herself to say about the mental process accompanying her multiple operations, viz., that the visual image of the words to be written is all the while before her mind's eye, so that she has only, as it were, to copy it. In fact, this visual picture will work as what the writer would describe as a mental (or psychic) pattern, controlling her hand with absolute safety even in the absence of any conscious mental activity. A partial check of this theory would be got by examining whether she can carry on together two actions of any character, or whether some parallelism, of the sort present when both actions are writing or playing or playing and writing, is necessary.

Another contradiction of the good old adage which denies the possibility of doing two things at once. This young lady can even do three, as the picture at the top of the page indicates

Miss Alba even takes advantage of her abilities in everyday life, writing her letters—for the sake of greater speed—simultaneously with both hands, viz., the first, third and fifth words with her left, and the second, fourth, sixth, etc., with her right hand. While generally writing outward, she is able as well to write inward with both hands.

The following theory is advanced by the writer in order to account for these extraordinary achievements: As long as an act of conscious will is required to perform a given operation, absolute simultaneity of several operations would, truth to say, be out of the question. As soon, however, as one operation (*e. g.*, as a consequence of previous training) occurs automatically, such as is the case, for instance, with the old lady knitting her stocking and simultaneously reading her novel, the mind will be free to control some other operation.

The Sense of Smell in Birds

IN a recent number of *Ibis* for 1922 Mr. J. H. Gurney discusses the question of the sense and smell possessed by birds. Mr. Gurney first deals at length with the observational evidence in favor of the existence of an acute sense of smell in certain species. Among these the rook and some woodpeckers are cited on account of the accuracy with which they seem able to locate hidden grubs. Various petrels are also mentioned, some of these being credited by good observers with the power, for instance, of detecting offal thrown overboard by fishing boats even in thick mist. Geese and ducks, too, have very frequently been thought to possess power of smell. The most striking case, however, is that of the vultures. It is indeed difficult to explain on any other theory than that of scent how these birds should know when a death has occurred in a house, congregating on the roof as if in the hope of gaining access to the corpse which they cannot possibly have seen; the same faculty was traditional as regards the raven, when that species was commoner than it is now. Against all this, however, there is a mass of testimony from naturalists and sportsmen that birds show little or no power of detecting the presence of an enemy, even if approaching down-wind, until either sight or hearing comes into play.

In view of the weakness of the evidence obtainable by direct observation, one would naturally look with hope to experimental methods. Bachman experimented with the American turkey-buzzard. Portions of highly offensive offal were wrapped in thin canvas; the birds seemed unable to detect the food even when eating pieces of meat which were in some cases strewn on the outside of the package, but as soon as a small rent was made for them in the canvas the prize was at once discovered. In America, Dr. R. M. Strong tried the effect of placing hidden food close to doves confined in boxes which could be regulated to admit or to exclude odors. Here again the result was negative, no notice being taken of the food by any of the birds. To these may be added the experiment carried out by Prof. Watson and Dr. Lashley on the noddy and sooty terns of the Tortugas Islands. These investigators were studying the homing faculties of breeding terns, and in some cases they tried the effect of sealing up the birds' nasal chambers with wax; here again no difference in behavior was observable. This last experiment is of special interest because it had for its object the testing of the theory that the olfactory apparatus may function not as an organ of smell but as a mechanism for detecting the temperature or humidity of the wind and thus as an aid to directional guidance during prolonged flight. The complexity of the sense organs in the insects, and the confusion of purposes which they serve, affords a precedent in favor of believing that this may be the case; and the intimate connection between smell and taste in the human is somewhat in the same direction.

There is, then, a well-developed olfactory apparatus in birds, and there are instances of behavior which are difficult to explain except on the supposition that an acute sense of smell exists in the species concerned. On the other hand, there is a greater mass of evidence of behavior suggesting that the sense is not developed to any important extent, and the results of experiments point in the same direction. More light would be shed on the question if an alternative explanation were presented of the more puzzling items of behavior.

An All-Steel Grandstand

THE erection of grandstands is one of the oldest forms of construction which history records, and from reasons of necessity it has changed very little in its outward form and general appearance. A returned traveler from Europe, after having seen the auditorium of an ancient Greek theater, or the seating arrangements of the Coliseum, will recognize on looking at the great stadiums of our universities that here is an architectural form which, dictated by the necessity of the case, inevitably has held to its original arrangements.

It is in the materials of construction, however, that the greatest changes have occurred. The Greeks built in their native marble; the Romans in timber for temporary erections, and in concrete and marble for those intended to be permanent. In the modern revival our earliest grandstands were built very simply of wood. With the development of reinforced concrete, wood gave place to this material, and the greatest stands in the world, built of concrete, are to be found in growing numbers throughout the United States. The accompanying illustrations represent a successful attempt to provide a grandstand construction of such simple and economical design as to render it ideal for its purpose. The structure shown in our illustrations, which provides about 9,500 seats, has been erected at the athletic field of the State University of Iowa. It was designed by Byron J. Lambert, Professor of Engineering and Chairman of the Board in Control of Athletics, and, as will be seen from our illustrations, it forms a compact, strong, and pleasing grandstand, which has the advantage that it is fireproof and can never be subjected to those conflagrations which from time to time have swept some of the steel and wood types of grandstands out of existence.

This shows plates, splices and supports for seats of the all-steel grandstand built for the State University of Iowa

South end of the all-steel grandstand, showing structure cantilevered out over river

The construction is as follows: The seats are built up of long plates bent along their edges so as to form a large Z-shaped cross-section. The central or wider part of the Z forms the tread of a seat-plate about two feet in width, the shorter portion of the bent plate forming the riser. The individual plates as thus formed (and it should be mentioned that the steel companies developed a method of doing this work cold) are riveted together at about the center of the riser, the upper section overlapping the lower, with the result that the structure is practically waterproof. It will be noted that each seat-plate in the riser consists of two thicknesses of plate. The section and thickness of the metal, and the spacing of the floor-beam supports, are figured so as to carry safely all the necessary loads as assumed. At the points where the seats rest upon the beams the seat-plates are butt spliced, so as to stiffen them and render the joint waterproof. At short intervals along the tread of the seat-plate, cast iron stool or seat brackets are attached to the seat-plate by stud bolts which are screwed into holes tapped in the seat-plates. Upon these brackets is carried a plank seat which is attached by bolts or screws. A study of our photographs shows how admirably the structure is designed for shedding water. With proper attention and periodical painting a grandstand of this type should have an indefinite period of life.

Death From Snake Bites

ALTHOUGH the average mortality from American venomous snakes is a little more than 10 per cent of the persons bitten, death from snake bites is quite rare, according to the Biological Survey of the United States Department of Agriculture, because relatively few persons encounter or are bitten by the dangerous species.

The most venomous of our native snakes live in lonely, little-settled districts, often on stony or swampy land that cannot be cultivated. Usually they disappear at the approach of man, and while they may strike if provoked, the popular belief in respect to the distance they can strike is erroneous. Three-fourths of their own length is about the greatest distance possible. If the legs are well protected when one is going into deep woods or places known to be infested by rattlers or other poisonous snakes, there is slight chance of being bitten by one of these reptiles.

As the food of snakes consists of living prey, they cannot be killed by poisoned baits. The only method thus far devised to kill them seems to be clubbing or shooting. This is best done in early spring, when they are still sluggish after the winter hibernation. Allowing hogs free run of infested land may reduce the number of snakes. However, the popular idea that hogs are immune to snake bite is probably based on the impenetrability by the venomous fangs of their thick skin and fat layer rather than on actual immunity of these animals.

The varieties most commonly found in this country are the Elapidae, or Harlequin snakes, and the Crotalidae, or "pit vipers," which include rattlesnakes, cotton-mouth water moccasins, and copperheads. Poisonous powers are commonly attributed to harmless species, and, even more, the names of such orders as the adder are locally applied to snakes with no poison properties.

Moisture Capacity of Soil Increased by Organic Matter

IN addition to adding plant food to the soil and improving its texture, organic matter, supplied by green-manure crops, stable manure, or in any other form, adds greatly to the moisture-holding capacity. It has been shown, says the United States Department of Agriculture, that while 100 pounds of sand can hold only 25 pounds of water and 100 pounds of clay 50 pounds, the same weight of humus or decaying organic matter will hold 190 pounds.

Clay soil containing organic matter is more friable than similar soil without organic matter. When the organic matter is entirely removed the clay remains compact during freezing and thawing. When the organic matter is returned the soil crumbles after freezing, just as the original soil.

Not only do the higher plants grow better in a soil rich in organic matter, but the activities of the soil bacteria are largely dependent on the supply of decaying vegetable matter. These bacteria need food and air. Their food is the dead vegetable matter, which they break down and make available to the higher plants. Most beneficial bacteria use air, and this they find more abundantly in a soil supplied with organic matter than in stiff clays. In sandy soils there is air enough, but the addition of humus helps to hold moisture and so benefits the bacteria as well as the higher plants.

Dam That Serves as Automobile Bridge

THE accompanying photos show the novel concrete dam of the Marin Municipal Water Project, located in Marin County across the bay from San Francisco, which not alone has many novel features as a dam, but which also serves as a bridge for automobile and vehicle traffic and pedestrians, eliminating the necessity of making a long detour around the lake and stream.

There is a roadway on the top of the dam wide enough to permit two vehicles to pass and a walk, which is separated from the driveway by a concrete ridge about a foot in height. Protection is afforded by railings of solid concrete on both sides of the dam.

The plans and details of the water system were prepared by City Engineer O'Shaughnessy and the entire construction work was under his supervision. The chief features are the 100-foot dam across the Lagunitas canyon creating a reservoir or lake with a net capacity in excess of 4,000,000 gallons and a 30-inch reinforced concrete flow main, connecting the water supply with the iron pressure mains of the former power company.

The outline of the dam is pecularily graceful and represents a somewhat novel type. One innovation is the absence of the ordinary spillway for storm waters, which naturally reduces the available level of the dam. In this dam flood waters are carried off by a system of six syphons, as shown in the photograph, built into the solid structure of the dam and involving no material loss of height. The future plans of the engineers contemplate a raising of the dam to an extra height of 60 feet with a corresponding widening at the base.

San Francisco's new bridge-dam, showing the overhanging top which provides the necessary width for two traffic lanes, and the siphons for carrying off flood waters without affecting the height of the dam

Pictures That Talk

Combining Sound Records with Motion Pictures to Obtain Talking Pictures

AFTER a lapse of several years, there is renewed interest in talking pictures—motion pictures accompanied by more or less realistic sounds. The origin of this idea dates back some 20 years, when pioneer workers in the motion picture art endeavored to couple up the crude projector of those days with the equally crude phonograph. Today, with highly perfected projectors and excellent phonographic devices, not to speak of the amplifying circuits and loud-speakers which have come out of radio broadcasting, inventors are again turning to the fascinating problem of talking pictures.

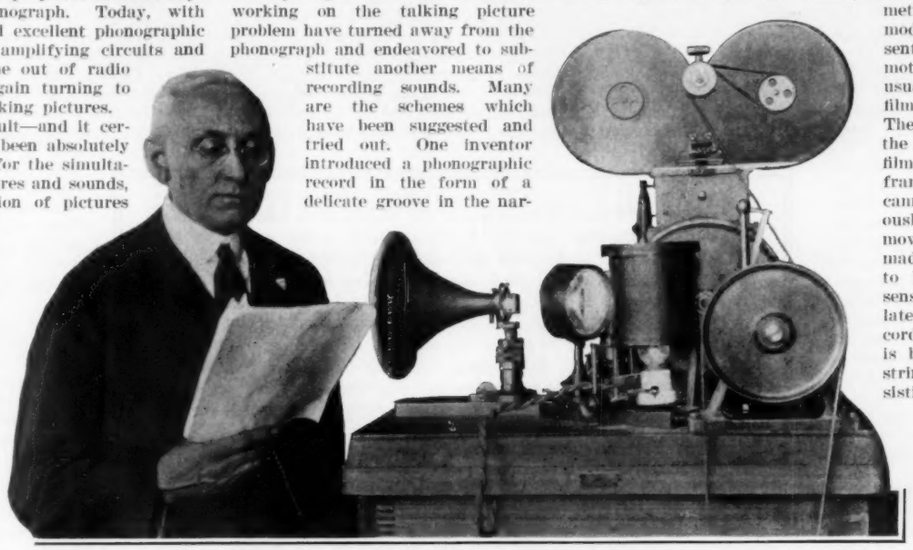
If the problem is still difficult—and it certainly is most difficult—it has been absolutely hopeless in the past. It calls for the simultaneous recording of motion pictures and sounds, and the simultaneous projection of pictures and sounds. Obviously, the pictures and the sounds must keep in perfect step throughout, otherwise the results are sometimes ludicrous and at all times unconvincing. Some of us may recall the early attempts at talking pictures, when the phonographic records would get ahead of the film or the film ahead of the phonographic records with very unfortunate results. So this keeping in perfect step, or synchronizing, as it is called, is of prime importance.

The motion picture member of the talking picture partnership stands as it is, without change of any kind. It must be combined with some form of sound record. All of the earlier attempts made use of cylinder or disk type phonograph records. An elaborate form of motor drive and governor served to keep the phonograph record in more or less perfect step with the picture projector. This synchronizing device has always presented the greatest problem, because the step must be perfectly maintained if the screen results are to be at all convincing. The projector has to be located in a fireproof booth at the rear of the theater, while the phonograph must be located near the screen so that the sounds will come from the same general direction as the images which are supposed to issue them.

As originally produced, the film and its accompanying sound record are of the same length and can be kept in step with a successful synchronizing device. But suppose the film is damaged and, in its repaired condition, is more or less shortened? Then the picture record and the sound record are no longer of the same length, and some means of shortening the sound record must be carried out to make it match the film record once more. When phonograph records are being employed, it is virtually impossible for the record to be altered, particularly by the usual motion picture theater personnel. And since motion picture film is often torn or broken in actual use, necessitating a new arrangement in which several "frames" have been left out, this is a most serious objection to the combination of a phonograph record and a film.

Aside from the difficulty of permanent and positive synchronization, the phonographic method of recording sounds for talking pictures leaves much to be desired. There is the scratching sound of the steel needle or jeweled stylus, which cannot be avoided and, if anything, is enormously augmented when the sounds are amplified to fill a large hall. Furthermore, the usual phonographic record is not as realistic as it might be, and little can be done to make it more realistic so long as we keep to the present broad principles. The phonograph records can accommodate but five or ten minutes of action on each cylinder or disk, and some suitable means of patching these various records together must be introduced to give an unbroken performance over a long period. It is obvious that a continuous record would be far more desirable.

Fully cognizant of these various facts, inventors working on the talking picture problem have turned away from the phonograph and endeavored to substitute another means of recording sounds. Many are the schemes which have been suggested and tried out. One inventor introduced a phonographic record in the form of a delicate groove in the narrow margin of the usual motion picture film, so that the pictures and the sounds, being carried together on the same support, must maintain absolute synchronism. Another inventor introduced a different kind of phonographic record in the form of little irregular nicks along the edge of the motion picture film, these little nicks being the latent sound values. Still another inventor introduced a tiny steel wire, imbedded in the film material and carrying magnetic impressions corresponding to the sound values. This wire, when passed through suitable mechanism, causes modulated currents to be set up and these currents, in turn, operate a loud-speaker which gives forth the original sounds. This magnetized wire acts in the same manner as the magnetized steel wire or disk of the well-known Poulsen telegraphone.



The voice waves cause the vibration of a tiny mirror placed at the small end of the trumpet or horn at the left of the table. A powerful beam of light is concentrated on the mirror, the latter reflecting the fluctuating beam on to the moving film through a suitable optical system. This is the recording device

Recording a speech on a motion picture film by means of the Pallo-Photo-Phone

TECHNICALLY, talking pictures must soon become a success. Workers in this field have such a splendid array of devices at their command—loud-speakers, amplifiers, tone purifiers, electrical filters, photo-electric cells, and so on—that it is safe to count upon the early appearance of a combination which will give perfect talking pictures. But admitting that talking pictures are possible and probable, will they supplant the present silent pictures? Despite all affirmative claims, we think not. The bald truth is that the present screen play is based on the silent drama technique; it tells the story by action and suggestion rather than by dialogue, now given in the form of titles. It has a wonderful appeal to its audience—an appeal entirely distinct from that of the spoken play. It is in no wise an imitation of the spoken play; it is a thing by itself. Why, therefore, replace it with a more or less realistic imitation? Our belief is that the talking picture has great possibilities in many directions, but as a factor in the motion picture field it must not be taken too seriously.—THE EDITOR.

All in all, it is pretty well admitted today that any successful system of talking motion picture must combine the sound record and pictures on a single film; any other plan only leads to trouble.

What appears to be the most promising method of combining sound record and pictures on one film is to record the sounds photographically at the same time and on the same film as the corresponding motion pictures. This method was worked out many years ago by Eugene Lauste, a Frenchman, then residing in England, where his talking pictures were exhibited with marked success. A description of the Lauste system appeared in our columns some four years ago. More recently, Lauste has been developing his system at Bloomfield, N. J., where he maintains an experimental laboratory.

The recording of sounds by photographic means is done in many different ways, and the truth of the matter is that today there are inventors at work on this same method in the United States, England, Sweden, France, Germany and even far-off Japan. The method is followed out with various modifications, but in its main essentials it remains the same. The motion pictures are made in the usual manner, either on standard film or on film of a larger width. The sound record is made alongside the motion picture "frames." The film moves intermittently—frame by frame—through the motion picture camera mechanism, and continuously before and after. While it is moving steadily the sound record is made. For this purpose the sounds to be registered are gathered by sensitive microphones, which modulate or vary an electric current accordingly. This modulated current is brought to the fine wires of a string galvanometer—a device consisting of fine wires placed in a powerful magnetic field, so that the slightest current flowing through the wires causes the latter to warp. A powerful beam of light is projected through the galvanometer strings and on to the sensitized motion picture film. Then, according to how much or how little the wires are warped by the current flowing through them, more or less shadow falls on the film which registers the results. Thus the finished sound record resembles the teeth of a saw, or the characteristic "peaks" of a statistician's graph.

For exhibition purposes, the same film is passed through the projector and sound reproducing device. The film goes through the projector mechanism intermittently, frame by frame, and steadily through the sound-reproducing device. A beam of light is passed through the sound record, and the varying degree of shadow, falling on a light-sensitive cell, causes a current of fluctuating strength to pass through a circuit which includes loud-speaking devices. Lauste has made use of selenium for his light-sensitive cell, which, as is well known, varies its electrical conductivity according to the amount of light falling on its surface. However, this mineral is somewhat sluggish in its response to light variations, and that sluggishness is often sufficient to interfere with successful results. More recently, workers in this field have developed other types of so-called photo-electric cells which are said to be sufficiently sensitive yet far more responsive.

Among the many talking picture systems now in course of development is the Pallo-Photo-Phone which is being developed by C. A. Hoxie of the General Electric Research Laboratories at Schenectady, N. Y. Following the present practice, it combines motion pictures and sound records on a single film. In this system the record is made by causing the sound waves to produce vibrations on an exceedingly minute and very delicate mirror. A beam of light reflected by this mirror strikes a photographic film which is kept in continuous motion. The film when developed shows a band of white with delicate markings on the edges, which correspond to the sounds which have been recorded. On account of the exceedingly small size of the mirror, its low inertia, and so on, it is possible by this means to produce a sound record which apparently includes the

(*Continued on page 71*)

Panama Canal Tolls

Revenue Loss of $8,000,000 Through Lack of a Proper Statutory Definition of Net Tonnage

By Crede Haskins Calhoun

THE Panama Canal lost $8,079,601.66 in tolls up to December 31, 1921, during approximately seven years of operation, due to the fact that a decision of a former Attorney General has prevented the application of the rules of measurement designed to fix the tonnage of vessels for the payment of transit tolls. This has resulted in an average annual loss of over a million dollars and an average monthly loss of almost one hundred thousand dollars. The total amount collected for tolls during the calendar year 1921 aggregated $10,325,718, and the loss amounted to $2,045,357.14 for the same period.

The Panama Canal rules for admeasurement of vessels as drafted by Professor Johnson, of the University of Pennsylvania, and approved by the President and Congress, are based on the principle that merchant vessels should be required to pay tolls on their tonnage, so measured as to express their actual earning capacity. To do this it was necessary to include deck loads and spaces used for carrying cargo not generally included as cargo space in existing rules of measurement.

Expert opinion approves the rules established for the Panama Canal and the Commissioner of Navigation wrote at the time the rules were formulated:

". . . The system of measurement which has been prepared by Prof. Johnson for the Panama Canal is the result of careful study and investigation, and of extended conference with the most competent authorities in England, Germany and France. It is without doubt the most exact application of the scientific principles which should govern the subject, yet prepared."

The term "net tonnage" as applied to a ship, is supposed to represent the space remaining for cargo, after deductions have been made from the gross tonnage for space used by power plant, bunkers, crew's quarters, etc., and is presumed to represent the true earning or carrying capacity of a ship. However, net tonnage as determined by rules of measurement of various nations has varied widely, due to the looseness of the rules and to careless application and the ability of constructors to build and design ships that would give the minimum of "net tonnage" and the maximum cargo capacity. In the computation of net tonnage in accordance with the rules of the various nations, no two countries would give a vessel the same net tonnage, and the application of the rules of any nation by two boards of admeasurers to the same or similar vessels does not often give the same result.

As an illustration of this, the Marine Superintendent of The Panama Canal calls attention to the following case: "An illustration of the vagaries of the United States rules is cited in the cases of the steamers 'Western Hope' and 'Westpool.' These vessels of recent construction, possess practically identical characteristics and earning power. They were measured at the same port (Seattle, Wash.), although by different admeasurers. The 'Western Hope' was assigned a net tonnage by United States rules 638.54 tons in excess of that of the 'Westpool,' amounting to about $800 in tolls per canal transit. By Panama Canal measurement, the difference in net tonnage as between the two vessels is less than one ton," concludes our authority.

The first hitch in the method of admeasuring vessels at the Canal came as a result of a protest against adding deck loads to the net tonnage for the payment of tolls. This resulted in a wholly unexpected and highly technical decision of the then Attorney General that has brought about the practical nullification of the Panama Canal rules and the substitution of the United States rules. This decision was rendered early in 1915 and it is responsible for the losses mentioned in the first paragraph of this article.

The law, known as the Panama Canal Act, which gave the President authority to prescribe tolls and rules of measurement contained this limitation: "When based upon net registered tonnage for ships of commerce the tolls shall not exceed one dollar and twenty-five cents per net registered ton." The President fixed the tolls at "one dollar and twenty cents ($1.20) per net vessel ton—each 100 cubic feet—of actual earning capacity." Naturally the limitation applied to tolls not to tons, and to tons as defined by the Panama Canal rules for measurement. Certainly a law authorizing a system of computing tonnage and collecting tolls on that computation when it refers to tonnage without specification or qualification, means the tonnage computed by the rules of measurement it authorizes.

Nevertheless, the Attorney General ruled that the term "net registered tonnage" as used in the Panama Canal Act did not mean "net registered tonnage" as measured under the special rules provided for the Panama Canal, but must be interpreted to mean the net tonnage of a vessel as measured under the rules prescribed by the statutes of the United States. This has made it necessary to measure or check the measurement of every vessel transiting the Panama Canal along two distinct lines to determine its Panama Canal tonnage or actual earning capacity and its "U. S. equivalent" or "net tonnage," according to the United States rules of measurement.

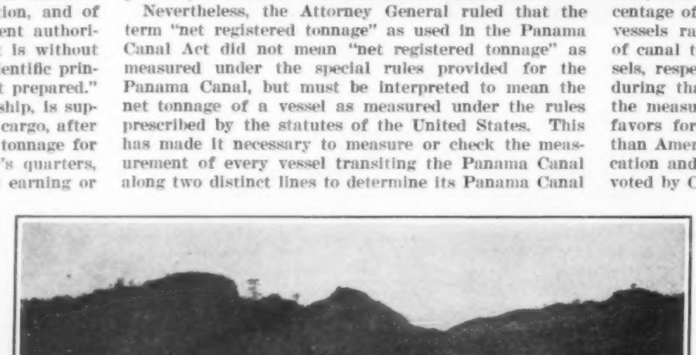
The procedure at the Canal has been to maintain tolls at the rate originally established by the President —$1.20 per net ton of actual earning capacity determined by the Panama Canal rules of measurement—so applied, however, that when the product of the tonnage thus determined multiplied by $1.20 exceeds the sum obtained by multiplying the net registered tonnage, determined by United States rules, by $1.25, the excess amount is uncollectible. As already pointed out, this uncollectible excess up to the end of the past year has amounted to over $8,000,000.

This has virtually resulted in a subsidy or bonus to all vessels using the Panama Canal and, unfortunately, American vessels have not received so large a share of this gratuity proportionately as foreign vessels. According to a report made by the Marine Superintendent of The Panama Canal in 1919: "The aggregate 'United States equivalent' net tonnage of 50 foreign vessels, whose names were selected at random from the Panama Canal files of transited vessels, was found to be 20 per cent less than their aggregate tonnage of actual earning capacity as determined by Panama Canal rules. In the case of 50 United States vessels similarly selected the difference was 14 per cent." From which it can be seen that American vessels are getting a subsidy of 14 per cent of their tolls whereas foreign vessels average a subsidy of 20 per cent of their tolls.

In a comparison of 23 vessels of various nationality, in which the percentage of Panama Canal "net tonnage" over United States "net tonnage" is given for all commercial ships using the Canal in the calendar year 1920, we find that the general average of all vessels is 21.4 per cent, and that the two highest averages are those of the Peruvian and Chilean register with respective percentages of 62.3 per cent and 52.6 per cent, over United States "net tonnage," while the percentage of British vessels is 23.1 per cent, and British vessels ranked next to United States in the number of canal transits. Chile and Peru had 79 and 78 vessels, respectively, that made the transit of the Canal during that year. While this devious application of the measurement rules favors practically all ships, it favors foreign ships to a considerably greater extent than American ships. It is a subsidy, uneven in application and unfair as to competition, that has not been voted by Congress; yet it is represented by money that should be collected and turned into the United States Treasury, but is not, due to the decision of an Attorney General. There are American ships on the same trade routes in competition with British, Peruvian and Chilean vessels, yet the Americans pay 4 per cent more tolls than the British, 43.2 per cent more than the Peruvians, and 33.5 per cent more than the Chileans.

Ever since the decision of the Attorney General was rendered in 1915 there has been legislation before Congress designed to correct this condition that greatly increases the difficulty of measuring ships at the Canal, and collecting tolls; causes unfair discrimination, unbalances competition, and costs the Government millions of dollars; yet to date no results have been obtained. A law of ten lines will stop this leak and it should be passed without delay; certainly so that the Canal can start the next fiscal year, beginning July 1, 1922, on a basis that will be fair to the ships of all nations and will make possible the collection of all the tolls earned.

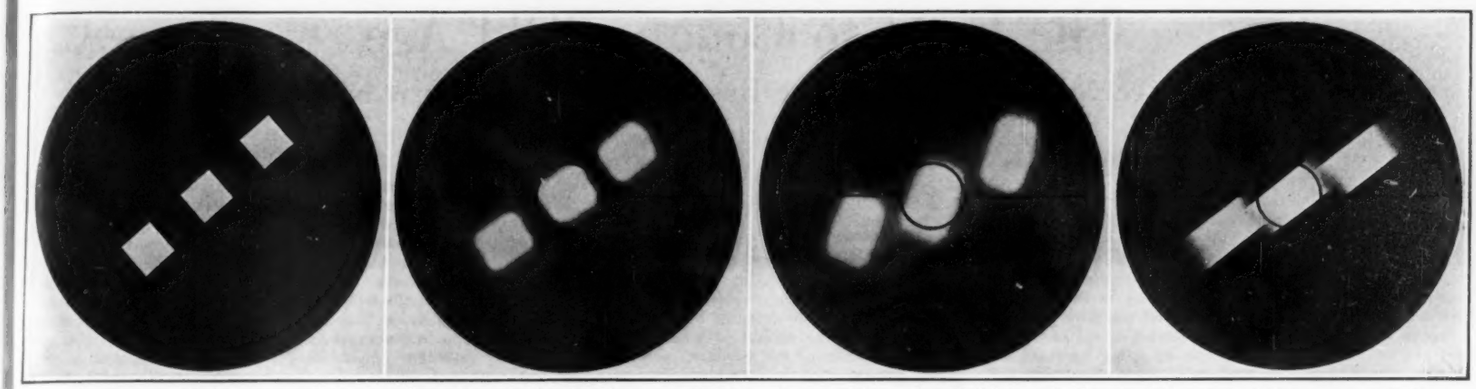
IT is high time that the taxpayers of the country were made acquainted with the amazing facts which are set forth in this article by Mr. Calhoun, who writes from Balboa in the Canal Zone. Here we have the greatest Federal work ever undertaken in the history of this Republic, which is being steadily "milked" to the extent of no less than two million dollars a year, and all for the want of a simple legislative enactment which could be passed any day, and without any possible question as to its propriety. We commend this article to the careful reading of the taxpayer, with the suggestion that he impress upon his representative the need for immediate action in the matter.—THE EDITOR.



An example of the deck loads that are carried through the Canal without paying toll

Radio Reference Lists

FOR the past two years the Bureau of Standards has prepared a semi-monthly report listing references to important articles of professional interest to the radio engineer appearing in current periodicals. Owing to the fact that this was a mimeographed report and could not be issued in very large numbers, its distribution was quite limited. Recently, owing to the greatly increased demand for these lists, it was decided to publish them monthly in the Radio Service *Bulletin* of the Bureau of Navigation, Department of Commerce. As this is a regular publication which may be obtained on a subscription basis at 25 cents per year from the Superintendent of Documents, Washington, D. C., the list of references will now reach a much larger number of persons interested.



Appearance of the targets in the eye-piece when the lens has been completely and accurately analyzed (left), and when typical errors of focus are present

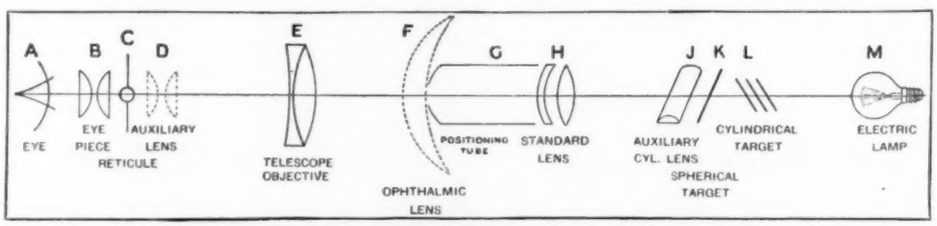
Research and Spectacles

The Lensometer, for Measuring the True Power of Ophthalmic Lenses

By Charles Sheard, Ph.D.

Research Laboratory, American Optical Company

NEARLY everyone knows that, when eyes are examined for defects of vision, test lenses have to be used as a part of the routine examination. The final prescription as determined by the examiner has to be made up in either eyeglasses or spectacle lenses. The science of ocular testing has changed considerably in the past 25 years, and, with the increased accuracy in the methods of correcting the errors of vision, has come marked progress in the manufacture of ophthalmic lenses. Our grandmothers and grandfathers and many of our mothers and fathers wore lenses which were biconvex or biconcave in form. These lenses have surfaces which have the same curvature on each side. The strength of any lens depends upon the curvatures given to the two surfaces. For instance, a pair of plus 3 diopter lenses, which might have been used by our fathers as reading glasses, were ground with a plus 1.5 diopter curve on each side. But such forms of lenses have a poor field of vision and the wearer is compelled to look through the center to get the best vision. In modern times meniscus lenses, having a cross-sectional shape similar to that of a new moon, have come into general use because of the greater and wider useful field of vision obtainable. These later forms have made it necessary to take into account in lens manufacture both the character of the curves used and the thickness of the lens. The true powers of these lenses cannot be obtained by the methods devised and used by the opticians of years ago. An instrument for quickly and accurately determining the effective power of any spectacle or eyeglass lens, as well as for determining the true effective power of any combination of such lenses as used by the refractionist in his ocular testing, has been recently devised by E. D. Tillyer and others at Southbridge, Massachusetts, as the result of many months of experimental work. The spectacle-wearing public is therefore insured of accuracy in the filling of prescriptions and in the duplicating of broken lenses through the use of the lensometer.



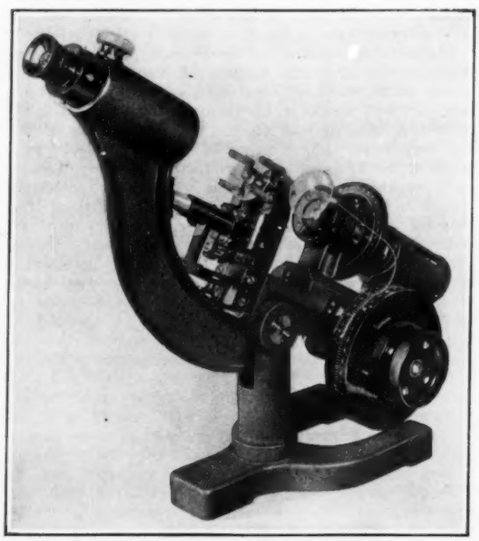
The optical details of the lensometer. For reference letters see the text

The lensometer in its present form reminds one considerably of a microscope. The details of the optical parts of the instrument are diagrammed. The source of light *M* is an electric lamp and this illuminates two targets, one of which *K* is used for measuring the spherical power and the other *L*, for measuring the cylindrical power. These targets are movable by means of two wheels at the side of the instrument. By the movements of these wheels the images of the two targets can be brought into proper focus at the eye-piece *A—D*, accomplishing the same effect as is obtained in the process of focussing a camera. The lens to be examined *F* is held in a suitable carriage; the lens may be anything from an uncut lens to one mounted in a spectacle frame.

The positioning tube *G* is so adjusted that the surface of the ophthalmic lens *F* which comes next to the eye is held exactly in the principal focal plane of the standard lens *H* so that the distance x from this point to the image of the target is given by the well-known optical equation, $xx' = f^2$, where x' is the distance of the target from the other focal plane of *H*, and f is the equivalent focal length of the standard lens *H*.

Changes in x or x', which are uniform for every diopter change of power, can therefore be converted into suitable dioptric values upon the wheels actuating the targets.

Some of the images of the targets seen in the eye-piece are illustrated. One of these four views, the first (at the left), shows how the targets appear when the lens being examined is completely and accurately analyzed. The second shows that the sphere is out of focus and no cylinder is present. The third shows the sphere in focus, but the cylinder out of focus and off axis a few degrees. The last figure shows the sphere out of focus, with the cylinder out of focus and off axis as well.



General view of the lensometer

The lensometer may be used for determining the true effective power or back focal length of any lens or combination of lenses in which the spherical power does not exceed 20 diopters, plus or minus, and in which the cylindrical element is not in excess of 8 diopters. In addition, the instrument carries devices for finding the optical center, spotting or marking this point as well as the axis of any cylindric element present, and permits the getting of all optical data with reference to any ophthalmic lenses already mounted in a spectacle frame or in eyeglass form.

The lensometer is, therefore, a universal instrument which is of inestimable service to optical manufacturers, to those examining and testing eyes, and to those filling optical prescriptions. It standardizes for the first time in optical history the measurement of the effective or true correction power of ophthalmic lenses.

Novel Means of Testing Levers

THE Bureau of Standards has devised a means whereby in certain work one weight can be made to do the work of ten. This is of importance in connection with the standardization of testing machines used in the various laboratories throughout the United States, and which now play a fundamental part both in the manufacture and sale of structural materials. These testing machines are standardized by means of rating levers, but before these levers themselves can be used they must be calibrated. Experience with scales and levers of all kinds has demonstrated that if they are to give dependable results they must be tested under full load conditions. These rating levers are large-capacity, high arm-ratio members which would ordinarily be very difficult to test under full load conditions. The very heavy load which is required on the short arm is not available, except in possibly one or two laboratories in the United States, and even in these laboratories its application would be attended with considerable difficulty.

In the new scheme which has been worked out, it is unnecessary to furnish a greater amount of weights than are employed in the regular use of the levers in standardizing testing machines. The levers are connected in a certain way, and the arm ratio of the combination is determined. The levers are then interchanged and the arm ratio experimentally determined as before, and from the two results the arm ratio of the individual levers can be derived.

The scheme devised for combining the levers offers several advantages. In addition to bringing a full load pressure on the knife-edges, the lever arms are maintained parallel, and the assembly is such that the difficulties of securing a structure adequate to support the levers while being tested are reduced to a minimum. A general description of this method has been prepared for immediate reference as Technological Memorandum No. 101.

The Fight to Conquer Old Age

The Rejuvenation Theory and the Results Achieved from it by Steinach

By Jerome Lachenbruch

SCIENTISTS are the greatest of all skeptics. They refuse to believe until they are shown every detail of a new discovery. And when a scientist hits upon an idea that has been baffling the world since Adam's birthday, and maintains that he has discovered a way to restore vitality to old and to prematurely old persons, the entire scientific world swarms about his ears and ridicules a man whose decades of research work ought to enjoy at least a scientific reception. No modern scientist has been so ridiculed and punned against in the press and by physicians as Professor Steinach. He is falsely accused of claiming that he has discovered a way to make people young. Professor Steinach would be the last man to maintain that point of view.

However, his experiments on rats and on guinea pigs, which resulted in making old animals of both sexes fertile after they could no longer reproduce themselves, are authentic. Fortified with innumerable successes in this field, he has applied his operations to human beings who have become old before their time. At the present time, the Steinach operation is being performed in many parts of Europe and America.

The effect of the Steinach operation on human beings is not as rapid or as pronounced, in most cases, as upon animals. In the case of persons, it is too soon to measure the value of the operation. In the first place, man is so much more complex a psychic creature than the smaller animals upon which Steinach experimented, that causes other than merely chemical ones exercise greater influence upon him. Besides, in guinea pigs, results can be tabulated very rapidly, for the pigs multiply rapidly and voluminous data may be obtained upon them in a comparatively short time.

In Professor Steinach's Institute in Vienna, he himself examines all persons desiring to undergo the operation. Some he admits to the operating room; others he tells openly that the operation cannot aid them. The most successful operations have been performed upon men who have become old before their time, either through overwork or through illness, such as tuberculosis, or through war wounds.

In the field of large animals, several operations have been performed, the success of which suggests an economic application of the Steinach operation. Several famous horses, used only for breeding purposes, have undergone the Steinach treatment and have had their reproductive function restored. The operation has also been used by sheep breeders with success.

Professor Steinach's researches are based on the idea that old age and premature old age are nothing more than a change in the chemical secretions of the ductless glands. These glands and their inner secretions are known with some degree of definiteness; and it has been firmly established that they affect the growth and the vigor of the body and of the mind. The best known glands of this type are the thyroid, which stands in a cause-and-effect relation with the growth of certain organs; the pituitary, upon the proper functioning of which depends the growth of the skeleton and the healthful condition of the nerve cells; the adrenal, the secretion of which enters the blood and energizes the body to meet sudden demands made upon it; and the gonads, the reproduction glands.

These glands weaken with age. Professor Steinach sought some way to utilize the life-giving fluid of the reproductive organs to stimulate the other ductless glands to renewed activity. His first discovery was that it was possible to segregate the two functions of the gonads, that of producing seed and that of supplying vital fluid. He found that if he removed the testicles from a male guinea pig and transplanted them into the muscular tissue of the animal, the guinea pig would lose its reproductive ability, but would otherwise retain its normal functions. In other words, the transplanted testicles continued to secrete the life sustaining fluid, which entered the blood stream, circulated through the body and reinvigorated all the other ductless glands. The next step was to try this experiment on an old normal rat. Here, the rat was not only invigorated, but its lost reproductive function was restored. The cells, then, that create the invigorating fluid, are the centers of this rejuvenation phenomenon. These are called the Leyden cells and are located in the reproductive organs between the seminal canals.

After Professor Steinach had gone this far in his researches, he tried his now famous operation on a rat. This consists merely of cutting the seminal cord on one side, and binding the loose ends firmly. The testicle, thus separated from the testes, remains in its normal position. What happens is that on one side, the little seminal canals shrink and leave interstitial spaces. These are now filled out by a rapid enlargement of the Leyden cells, which begin to produce fluid at their youthful rate. This is absorbed in the blood stream, and eventually invigorates the other glands in the body, and finally the remaining reproductive gland. In many cases, the patient again becomes fertile. Certainly, the operation has restored the power to work to many men who had never hoped to work again.

The application of the Steinach theory to human beings has resulted in many men who have become prematurely old being restored to a vigorous middle age. His discovery does not mean that we shall never have to grow old; but it does mean that unnatural old age can be alleviated. It is a disease, and Steinach believes he has found a way to cure it.

Apparent Death and Resuscitation

A Discussion of Causes, Symptoms, and Methods of First Aid

By Ismar Ginsberg

THE OLD adage of the cat and its nine lives is sometimes applicable to humans as well. A man is not always dead, when he appears to be so. There are many factors which can bring about so-called apparent death. The knowledge of these and the means of overcoming the temporary suspension of bodily function resulting thereby are of primary importance.

Death takes place through cessation of the heart action, stopping of respiration, or through the suspension of certain vital centers in the central nervous system. These three functions of the body, which are essential to life, are so inter-connected in the body complex that the functioning of any of them cannot be interrupted for any great length of time without serious results. We can all stop breathing for a certain length of time, and there has been known one case at least of a man who could voluntarily stop his heart beating for about 20 seconds. Cessation of the functioning of the nervous system centers even momentarily is not known.

The causes which can produce apparent death are: Poisoning with such substances as morphine, opium, veronal, belladonna, hydrocyanic acid, chloroform, etc.: the breathing of irrespirable gases, such as chlorine, carbon dioxide, carbon monoxide, illuminating gas, and others; drowning, hanging, strangling, freezing, suffocation; shock by a strong electric current or by lightning; loss of much blood; going without food for a long time, perhaps in conjunction with cold; violent spasms or fits as in epilepsy; overlong delivery at childbirth, known as blue and white apparent death; hysteria and catalepsy; cholera and other exhausting sickness; severe body strain. The action of any one of these causes may produce death by interfering with the normal operation of the heart, lungs and nervous system. It is only necessary for one of the trio to be affected for apparent death to occur, as the connection between them in the body is so intimate that when the normal operation of one is impaired or stopped for even a short period of time, the others are affected similarly almost instantaneously.

There are, of course, certain victims of apparent death who come to life again without any external aid. Among these may be mentioned principally cases of apparent death caused by poisoning with morphine, etc. However, in the great majority of cases help is required to prevent apparent death from becoming absolute death. What strikes the layman first in a case of apparent death is cessation of breathing, and as it is not always possible that a skilled physician be present at each case of such death, it is important that all laymen know exactly what to do on such occasions.

Artificial respiration is most used at the present time, as the sovereign method of combating the apparent death which is caused by poisoning with various narcotics and alkaloids, by asphyxiation with gases, by drowning, hanging and also in the special case of the new-born babe. The freeing of the confined air passages in the lungs by the introduction of sharp liquids, such as strong vinegar mixed with finely powdered pepper and stinging nettle seeds, or through the blowing of sharp materials, such as snuff, into the nostrils were common methods in times past. Today there are numerous methods of reviving apparently dead people, and these are divided into two large classes. The first class includes those methods in which artificial respiration is induced by the aid of instruments and apparatus, and the second class includes those methods in which no apparatus is used.

It is claimed that, cases of apparent death being of such rare occurrence that the apparatus used for revivification is used but seldom, resuscitation with the aid of instruments and apparatus is the more unreliable of the two. For it may happen that the apparatus is out of order due to infrequent use, and then, if through ignorance it were not possible to apply the other method of resuscitation, the patient would be lost. While there does not not seem to be any reason why this apparatus cannot be kept in proper condition, it is stated that the quickest, safest and most reliable method is that using no instruments.

There are two different principles whether instruments are used or not. According to the first principle force is applied externally to the thorax and this is actuated in similar manner to natural breathing. It is artificially distended so that air is sucked in, and then squeezed together so as to expel the air. The latter operation can be performed automatically through the elastic reaction in the lungs and thorax.

According to the second principle breathing is induced by actuating the lungs themselves. During the process of inhalation air or oxygen is forced into the lungs, while in exhilation the air or oxygen is sucked out of the lungs by suction pumps or through the natural elastic reaction of the chest cavity.

The thorax method fills up the lungs with air without directly actuating them, while the second or lung method subjects the walls of the lungs and the thorax as well to active distention. It is evident that the lung method is directly the opposite of natural breathing, and consequently it is unphysiological in nature. This brings up the question whether the use of the pulmotor is justified, whether the use of this apparatus in forcing air into the lungs and sucking it out again by mechanical means is harmful to the subject.

From an examination of cases of apparent death due to suffocation, the essential feature of which is the deprivation of the body of sufficient oxygen to perform its natural functions, it appears that this non-physiological or pulmotor method of artificial respiration is not only unharmful but absolutely life-saving in its action, as long as the nervous centers controlling the respiratory organs of the body are still capable of being stimulated into action. If they have lost this power, then it makes no difference what method is used; they cannot be brought into action again and the victim is definitely dead. The use of an excess of oxygen does no harm, as under normal conditions arterial blood is almost completely saturated with oxygen anyway.

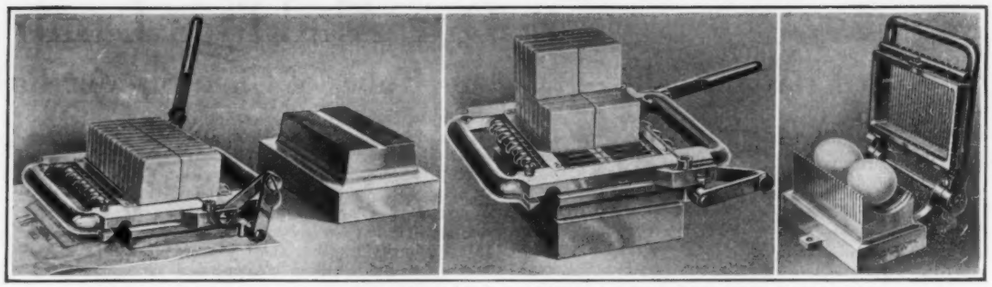
Mechanical Packaging of Foodstuffs

THERE are many cases where machinery can be utilized with advantage for preparing foodstuffs in units of economically marketable size. We show three such devices, two of which are applicable only to butter and the third to fruits, vegetables and eggs.

The first device is intended for butter merchants and does not come within the field of household devices at all. Many customers prefer their butter in the form of prints, and 60 per cent of the butter sold in New York City retail stores is thus prewrapped. In the large dairies and in the establishments of the commission men much of the work is done of converting the butter from the bulk to the print form. This work is done with the aid of electrically operated cutters. Formerly a table press was employed, but this process was too slow. The device shown is adapted to use by the average dealer in dairy products. The machine shown can produce prints of one, one-half or one-quarter pound direct from the butter of the firkin. The prints are perfect in shape and the weight is always the same, as means is provided on the handle to adjust the size according to the density of the product. When the butter is very hard in cold weather the mold of the machine may be plunged into a pail of lukewarm water to facilitate the molding and the release of the print. The instrument is then driven by hand directly into the firkin of butter for a short distance. A wire then traverses the entrance to the mold, at right angles, separating the butter in the mold from the main mass in the firkin. This permits the instrument to be withdrawn with the print, which is ejected by operating a plunger. When half-pound prints are desired the cut-off wire is duplicated at the center of the mold, so that when it is finally ejected the butter is in two half-pound prints. For quarter-pound prints a stationary central wire is added, which divides the two half-pound sections longitudinally as they emerge from the mold. With this machine no butter is lost and the prints are always fresh.

Those who conduct hotels, restaurants and boarding houses early discovered that the common butter plate was wasteful if nothing is said of the sanitary aspects of the matter. The little device shown is a great improvement over what has gone before, and is so rapid that notwithstanding the fact that it is operated by hand it can be made to produce 1000 patties of butter in one minute, but not, of course, in the hand of a novice. The butter print is opened up on its own wrapper and without further handling it is divided up into patties. The machine is forced over the print of butter (which still lies in its own wrapper). The handle is then thrown, actuating a "cut-off" wire which divides the prints that have been formed by the wire-grid so that one-half of the patties have been formed from one-half of the print. The machine is then forced down over the metal base shown at the right which cuts the remainder of the patties from the lower half of the print. The upper and lower half adhere during the entire time required, but they can be easily separated for use on the table. The wires are made of No. 8 tinned music wire and are so arranged in their mountings that twelve different sizes of patties can be cut.

The third device is intended for slicing eggs, beets, bananas, cucumbers, raw or boiled potatoes, peeled apples, peeled tomatoes, carrots, etc. It not only cuts faster than a knife but every slice is of the same thickness, which is of special value in the case of potatoes which are to be fried. The edges are not frayed as when knives are used. The base plate like all the rest of the device except the wires is an aluminum casting and the grooves are accurately milled out so that the wires come down with proper alinement. The wires are tightened with a screw. In operation the articles to be cut are placed as shown, and the top swung down. The wires pass through the eggs, etc., and into the slots provided for them. This is a fascinating kitchen tool to work and the product is extremely uniform. Tin contraptions costing a few cents might answer for a few days, but the success of a device like this depends on heavy castings accurately machined which will give a life-time of wear.



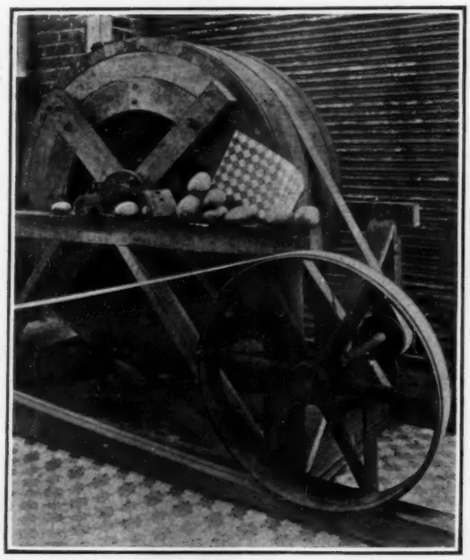
Left and center: Cutting butter patties without handling. *Right:* Egg and vegetable slicer of similar design

Making individual servings of food without handling

Inundated Sand Investigation

THE Bureau of Standards has started an investigation to determine the feasibility of measuring sand for concrete in an inundated condition. With small additions of moisture to sand, the sand "swells"; that is, the volume occupied by a given quantity of sand increases, and this increase sometimes reaches an amount as large as 38 per cent of the original volume. Conversely, the quantity of sand in a measure of given size varies greatly with the amount of moisture in the sand. This fact makes it difficult to insure the same proportion between sand and cement in successive batches of concrete because the percentage of moisture in sand varies greatly from time to time. Preliminary investigations have indicated that if the vessel in which the sand is measured contains sufficient water to submerge the sand, the same quantity of sand can be placed in the vessel regardless of the quantity of moisture originally contained.

The investigation is to determine whether the measurement of sand inundated will effect uniformity in the proportioning of sand to cement and consequently uniformity in the strength of the concrete. An affirmative answer to this question would mean the solution of one of the most troublesome problems in the concrete industry.



Testing carpets and oilcloths in a revolving drum, where they suffer a year's wear in a few hours

Thermomagnetic Analysis

IN any study of the physical properties of materials the effect of temperature is of great importance. It is well known that at a certain temperature ferromagnetic materials lose their ferromagnetic properties and become very feebly magnetic. It is not so well known, however, that certain more or less abrupt changes in magnetic properties take place at lower temperatures during heating or cooling and that these changes are often indicative of structural transformations in the material. The Bureau of Standards has designed and constructed apparatus for the purpose of investigating these phenomena. So far as the Bureau is aware, little, if any, work of this nature has been done in this country, although valuable results have been obtained by this method abroad. The operation of the apparatus is now under investigation but it should soon be available for study of the magnetic transformations taking place in ferromagnetic materials upon heating and cooling.

Revolving Drum for Testing Floor Covering

THIS revolving drum subjects samples of floor covering to all the hard knocks that the material would receive if actually placed on a floor. Samples of the floor covering are tacked to the internal circumference of the drum. Pebbles of Belgian flint, some sand and a flat piece of steel are placed inside the drum. By running the drum for 14 hours the pieces of floor covering under test receive the same wear that they would get if subjected to three to five years' wear on an ordinary floor.

The pebbles give the same results and wear as foot steps of human beings, and the piece of steel sliding along the surface gives the same wear as a person sliding on the floor covering. The sand grips the samples.

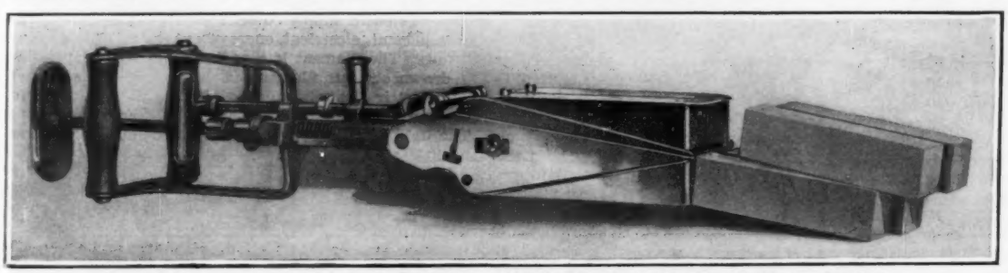
Attempt to Measure Exposure of Dyed Samples in Actual Units of Measurement

IN going over the present method of determining whether a sample of fabric or yarn is fast to light and such tests as laundering and acids, the result is usually expressed as "fair," "poor," and a few other general terms which are really no comparison at all. Therefore, the Bureau of Standards has begun an investigation to replace this unsatisfactory procedure by the use of definite units of measurement.

The program for carrying on this work consists of measurements by the various commercial instruments now available and those specially designed. The investigation will, in addition, give some information on the value of the commercial instruments for this particular test. The method consists of a selection of a large number of piece-dyed and yarn-dyed fabrics of various tones and colors, obtaining a spectral reflection curve of the various materials. Samples are also put into various instruments for comparison before exposure. On a definite period of exposure, the samples are taken in and similar tests repeated throughout the course of six months.

The interesting part of this investigation is in the use of an instrument, designed by the Weather Bureau and used at the American University where the samples are being exposed, which records the amount of sunlight with respect to its intensity rather than so many days of exposure and so many hours of sunlight.

The investigation really embodies those measurements which are considered most accurate in all parts of measurement. This work will probably take eight to twelve months and will be available to all interested.



Device for scooping butter from the firkin and delivering it in pound or half-pound prints

Our Aladdin's Lamp

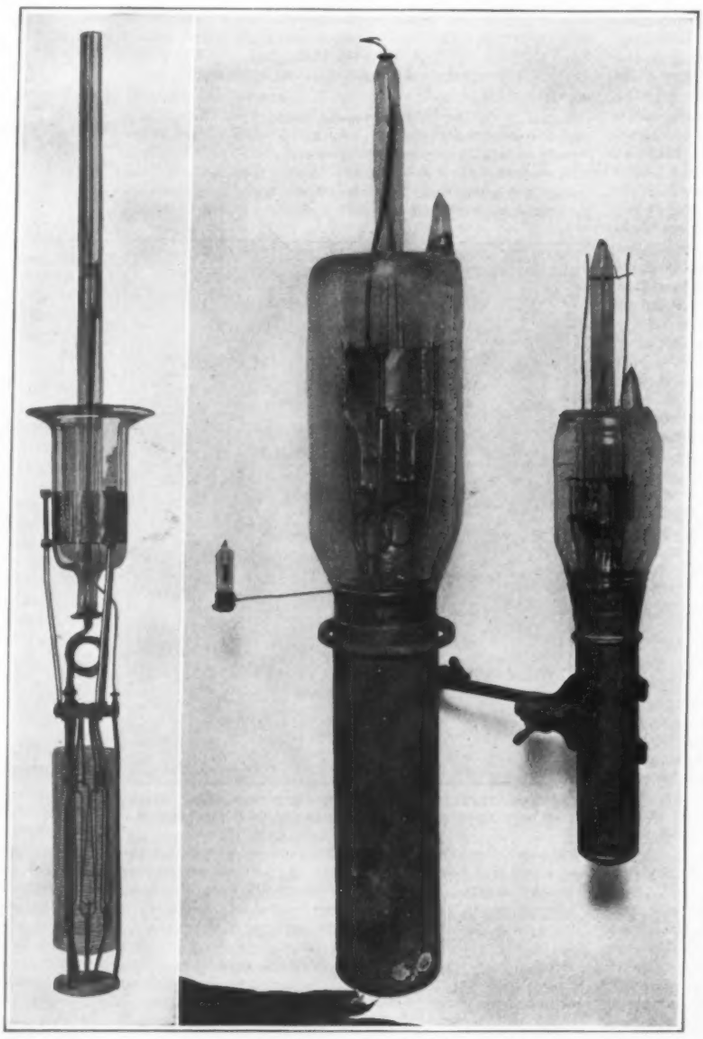
Recent Developments in Vacuum Tubes of Giant Size for Radio and Power Transmission

IT WAS in 1915 that the human voice was hurled across three thousand miles of space between Arlington, in Virginia, and Paris, in France. For this ambitious purpose, several hundred vacuum tubes were employed at the transmitting end, because at that time there was a definite limit to the capacity of any given vacuum tube, and the only manner in which large volumes of radio energy could be so obtained for radio telephone purposes, was by using a plurality of tubes.

But the main point in this retrospective view is that the vacuum tubes of that time, being little more than glorified electric lamps, were constantly burning out. Indeed, it was stated at the time that the short-lived performance of the vacuum tubes, together with the large number required at one time, made this method of communication far too expensive and uncertain for everyday use.

Let us skip the intervening years. We arrive at the present day, when hundreds of thousands of everyday folk are using little vacuum tubes in their receiving sets for the purpose of listening to the broadcasting programs. The broadcasting stations are using 50-watt or 250-watt vacuum tubes for transmitting, with little trouble and at a low cost. Certain ship stations are working with vacuum tubes which are the very essence of reliability and simplicity of operation. And to cap the climax of vacuum tube development we are now confronted with 100-kilowatt tubes and even 1000-kilowatt tubes—tubes which when used in single units deliver as much radio energy as is employed in most of the long-distance transmitting stations. Instead of elaborate alternators with a multiplicity of switching gear, lubricating facilities, water-cooling tanks and whatnot, subjected to all the wear-and-tear and constant nursing of all revolving machinery, we have a simple glass tube of modest dimensions which does the work in a quiet and thoroughly efficient manner. More than that, this same tube may well come to replace the costly generators now employed in our present-day electrical transmission systems, and may solve the problem of bringing electricity over hundreds of miles of transmission line, as recently outlined in these columns.

A vacuum tube not as large as an electric light bulb suffices for the modest requirements of the radio amateur and radio novice. It consists of nothing more than the usual electric light filament which is brought to incandescence by a storage battery or dry cell, according to the type, as well as a surrounding helix of fine wire known as the grid, and a large metallic surface known as the plate, which surrounds the grid and the filament. The broadcaster makes use of a large vacuum tube of 250-watt capacity. And now comes a vacuum tube of 400 times that capacity —a 100-kilowatt tube measuring three feet in length and from four to six inches in diameter. More startling still, there is a yet larger tube, of somewhat different form but for the same general work—one of 4000 times the capacity of the usual broadcasting transmitter tube, measuring a few inches in diameter and standing as high as a man.



Two giant water-cooled vacuum tubes compared with a small vacuum tube used in receiving work, and the working parts of the giant tube

But let us start with the 100-kilowatt first, which is enough of a jump from what we have been dealing with in everyday radio work. This new glass-bound giant has been developed by W. G. Houskeeper and Dr. M. J. Kelly in the Bell System Research Laboratory at the Western Electric Company of New York. There have been plenty of obstacles to overcome in the interval between the time when these research workers decided they wanted the big tube and the time when they were satisfied they had it.

In its simplest form the usual vacuum tube, as already pointed out, consists of a filament, a plate, and a grid mounted in an evacuated tube. In operation, a stream of electrons, or negative "corpuscles" of electricity, flows from the filament to the plate. This flow takes place only when the filament is heated, and its magnitude is controlled by the grid. When such a tube is in operation a considerable amount of heat is generated at the plate and must be taken care of in some manner. Radiation solves the heat-removing problem in the small tubes, but there is a definite limit to the size of a tube that can be depended upon to keep its temperature down in this way.

Experiments made it clear that when a glass container is used to house the usual form of construction, a tube depending solely upon radiation to rid itself of surplus heat could only handle from one to two kilowatts at the utmost. It was clear that some auxiliary system of cooling would probably have to be applied to any tube that was to operate successfully above these limits.

Several years ago, experiments were conducted by some of the engineers of the Bell Research Laboratory with a form of tube in which the anode or plate was a tube or thimble of platinum sealed into a glass vessel and kept cool by passing water through it. As soon as the pressure of war work left him free to follow up the idea, Mr. Houskeeper set about definitely to improve the water-cooled tube and carry its development along.

Now the water-cooling plan required, of course, that those metal parts most subjected to heating should come directly into contact with the cooling water. Instead of platinum, Mr. Houskeeper decided to try copper as the anode material. His plan called for a plate which, instead of being supported inside of a glass bulb, was in the form of a large metal thimble. This thimble, which had very thin walls, was to be attached to the glass structure of the tube with a vacuum-tight seal, and it was at this point in the problem that Mr. Houskeeper determined to carry further one of his own discoveries made some time before in connection with the sealing-in wires of small electric lamps used in telephone switchboards. He finally succeeded in making a perfect seal between the metallic and the glass parts of his giant tube.

As our accompanying illustrations show, the new water-cooled vacuum tube carries the filament within the cylindrical plate. This whole structure is placed within the copper anode and is concentric with it. Cooling water is circulated around the outside of the anode, and it is, obviously, necessary to guard carefully against any minute holes in the plate which would admit air or water vapor to the evacuated chamber. To meet this exacting requirement, thimbles are being drawn from single disks of copper.

The manufacturing of such a large tube has brought up a host of glass-blowing problems all its own. For one thing, the anode is so heavy that it is necessary to suspend it in gimbals while the tube seal is being made. Special devices have also been required to hold the filament-grid assembly in place while it is being sealed in.

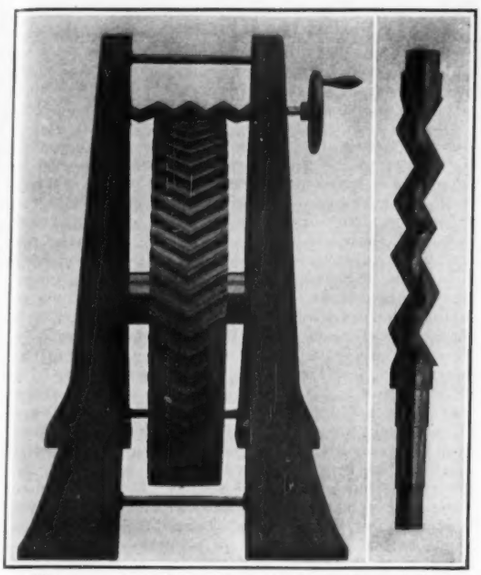
Pumping or exhausting these tubes presented more difficulty. This was chiefly on account of the large volume of occluded gas contained by the metal parts. The pumping time was consequently protracted. Frequently, dangerous warping of the internal structure would occur, due to the fact that during the exhausting process the tube elements are maintained at a much higher temperature than they are ever subjected to during operation. By using a vacuum furnace and heating the parts to an extremely high temperature, this difficulty was overcome. The vacuum furnace heating was done prior to the final arrangement and it was found that this method got rid of a large amount of the occluded gases. Before the glass seal is made, the anode is preheated, and the whole filament grid assembly is preheated just before it is mounted on the glass stem. This preheating greatly reduces the time required for the pumping process and produces a fine uniformity in the product.

In connection with the illustrations of the completed 100-kilowatt tube, some figures may add interest. The copper anode is 14 inches in length and 3.5 inches in diameter. Tungsten wire is used for the filament. It requires a current of 91 amperes to heat the filament, and the power consumed in this manner amounts to 6 kilowatts. Copper wire one-eighth inch in diameter is used for the filament leads and a special disk seal is employed where the leads pass through the glass walls.

So much for the 100-kilowatt tube. In the Research Laboratories of the General Electric Company at Schenectady, N. Y., there has been developed a 1000-kilowatt tube, weighing 60 pounds. The tube could supply current for 40,000 25-watt lamps, or sufficient electrical energy for about 1500 average homes. The filament is a rod of tungsten so large that if drawn out into filament of the size used in the average electric light, it would make 50 miles of filament; or it would make a filament for 175,000 such lamps. The light given off during the operation would amount to 40,000 candle-power.

The tube was proposed by Dr. A. W. Hull and is called by him the magnetron. It consists essentially of a water-cooled cylindrical anode 30 inches long and 1¾ inch in diameter. In the axis of the anode is a tungsten filament 0.4 inch in diameter, and 22 inches long. This filament is excited by current of 1800

(Continued on page 71)



The gear assembly with a single tooth, and the unique pinion shown separately

A Gear With Only One Tooth

THE question often arises as to the highest ratio which can be obtained by a single pair of spur gears. In order to obtain very high ratios, pinions with a small number of teeth, as low as three, have been used, and it has generally been considered that three teeth was the minimum number. By utilizing the helical principle, however, an English engineer has succeeded in making a practical one-tooth gear pinion. The photograph shows it in gear with a wheel having 63 teeth, the ratio of the combination then being 63 to 1.

The design is simple enough. As the teeth are helical and as half the face width is equal to the axial pitch of the pinion, there is continuity of contact throughout every stage of engagement. A gear designed in this way with straight teeth would be unworkable, but the helical formation makes this particular gear quite practicable. All phases of engagement are in simultaneous contact, so the transmission is uniform and positive.

This gear has great interest for the student and the engineer, and value for research or experimental work. It may be interesting to note the design details of this gear. The wheel has 63 teeth and the pinion only one; the ratio of the outside diameters is, however, only 18¼ to 1. The tooth pitch is 1.595 inches circular, and the respective pitch circle diameters are 0.508 and 32.004 inches. But, although the pitch-circle diameter of the pinion is only approximately half an inch, the actual strength due to the abnormal outside diameter is sufficient to transmit, without undue deflection, sufficient power to make the gear highly practical.

The gear illustrated has been run under power for a trial period and it has transmitted 10 horsepower at 1000 revolutions per minute of the pinion without any signs of wear or distress. It may be noted that the wheel works quite well as the driver, which shows that the efficiency is high. Using the pinion as the driver, the efficiency is as high as with any other double helical gear; that is, in the neighborhood of 97 to 98 per cent. It will be noted from the diagram that nearly all the tooth contact is what is known as recess; that is, it takes place when the pinion is going out of engagement with the wheel. This tends towards efficiency in work and in lubrication, because the oil is always being drawn into the line of contact, and the surface of the pinion becomes highly polished.

If a gear of the same size as the gear illustrated will transmit for a reasonable period in actual service the power stated at the given speed, it should prove of great value in practice, because the diameter of the wheel is small for such a high ratio. The usual method of dealing with such a high ratio is to use a double reduction spur gear when any considerable power has to be transmitted. For light drives, when it is desired mainly to transmit motion, a worm gear is used, but it is well known that high-ratio worm gears are inefficient. The new gear is much more compact, more efficient, cheaper to produce and altogether more economical than a double reduction gear.

Escape From the Garbage Can

AMONG the worst nuisances of the modern householder are the garbage and refuse cans. Many expensive methods have been employed to eliminate their ever-present objectionableness. Burning garbage on the premises where it originates is the latest solution.

By a special arrangement of grates, oxygen is fed to the flames at the top of the burning material, so the fire is always on top of the material being incinerated. As the heat liberates gases from the material underneath, these gases pass up through the flames, are mixed with the plentiful supply of heated oxygen at that point and are consumed. The by-pass grate and the by-pass flue keep the fire always on the top of the material being incinerated.

Suppose the householder begins on Monday to use the incinerator depositing through the receiving hopper door all household waste from time to time, as it accumulates (newspapers, wrapping paper, tin cans, garbage, etc.) repeating this every day until the incinerator is about full. This will take from three to six days. This material distributes itself in a separated and loose condition, permitting the draft, fire and heat to circulate through and around the moist material. When the incinerating chamber is nearly full it is lighted and the whole mass will burn without further attention.

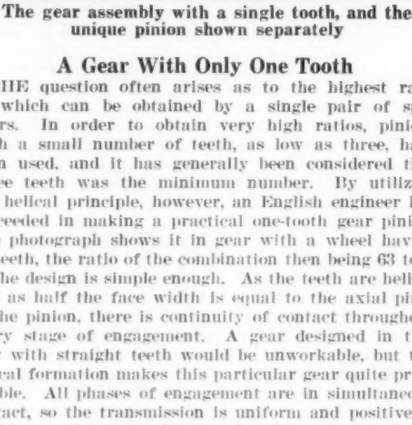
Watermelon rinds and other large pieces of vegetable matter may not be entirely consumed at the first burning, but they will be smoked, sterilized and dried to parchment, and will be fuel for the next burning. After about five or six burnings, the ashes and what is left of the tin cans, etc., that have accumulated on the grates, are dumped into the ash pit and are taken out with the rest of the ashes every few months.

The Talking Thread

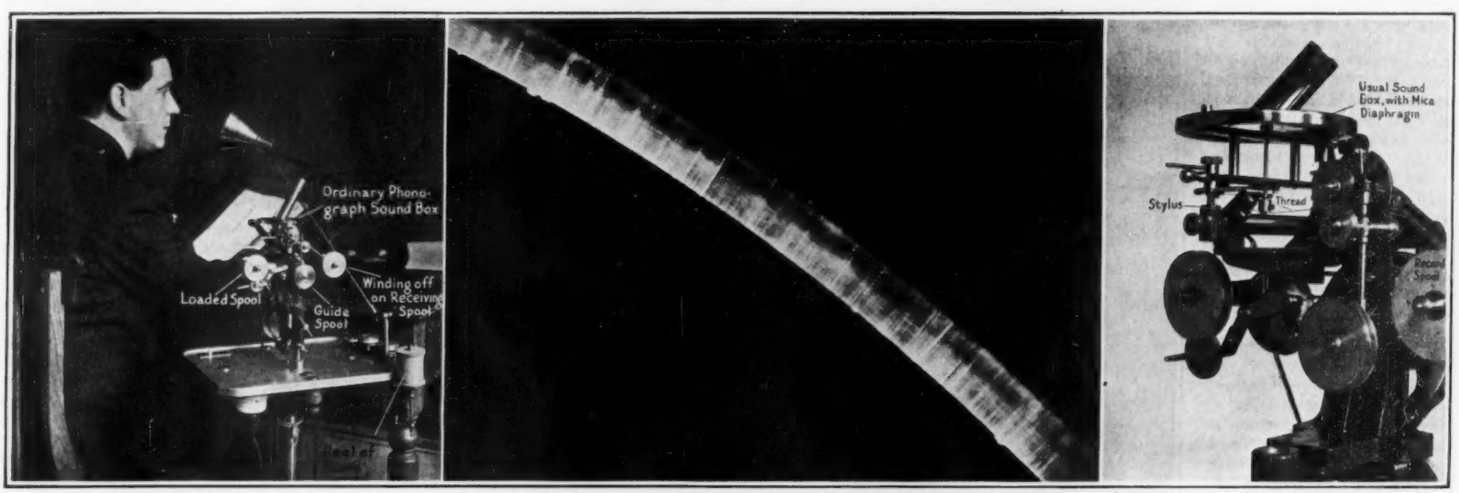
COMPETITION for the phonograph is promised by a recent Swiss invention, which is being developed by Mr. W. F. Croll, of London. The place of the wax cylinder or disk is taken by nothing more substantial than a fine cellulose thread. Recording and reproduction are on much the same principle as in the phonograph proper. Speech is delivered into a small horn attached to the usual type of gramophone sound-box. The sound-waves cause the mica diaphragm to vibrate, and these vibrations are conveyed by a slender rod to the sapphire stylus which is shaped like a tiny safety-razor blade. The unrecorded thread is contained on a spool, and the loose end of the thread is attached to another winding-off spool. When a record is being made, the thread travels from one spool to the other by electrical or even by hand motion, and, in doing so, lightly rubs against the edge of the stylus, and so becomes impressed with the effect of the sound-vibrations.

Here one may well ask, Why it is that the thread, which in its original state is circular in section, will always pass beneath the stylus with the sound-wave impressions uppermost? This is due to the fact that the thread has a certain amount of natural stiffness, and being wound in the shape of a coil automatically tends to keep its outer surface uppermost after having once been coiled round the containing spool.

The advantages urged in behalf of the new form of reproduction are its cheapness and its compact form. It is suggested that thread records may be mailed in an ordinary envelope; while a record of ten minutes' dictation, equal to four pages of typewritten matter, may be stored beneath the lid of a watch. It is hoped to install the talking thread in conjunction with the telephone, to act as an automatic recorder of calls received in the absence of anyone to answer the telephone. The Editor of *Illustrated London News*, to whom we are indebted for our facts and pictures, assures us that he has seen the instrument, talked into it, and listened to the reproduction.



Garbage incinerator for household use, built into the chimney



Dictating into the talking thread machine

A specimen thread-record, enlarged photo-micrographically about 50 diameters

Details of the new apparatus

New and compact phonograph in which the sound waves are impressed upon a fine thread

Leaves from the Archaeologist's Note-Book

What Pick and Shovel Have Revealed of Early Civilizations in Crete and Other Places

ARCHAEOLOGY, handmaiden of history, is occupying more and more the public eye; often we find a whole page of the daily paper devoted to one phase of the subject—a phase which 20 years ago would have been dismissed in 20 lines. The illustrated journals publish elaborate articles, giving in minutest detail information which at one time would have been buried in the publications of the learned societies. We have not space, in the SCIENTIFIC AMERICAN, for such liberal treatment of this subject as some of our contemporaries accord it; but it is one which we cannot pass by in silence. We propose, therefore, to carry from time to time, under the above head, archaeological material, illustrated or unillustrated, long or short, as the case may require.

The Lost Civilization of Crete

Sir Arthur Evans has come safely through the press with the first volume on his epoch-marking discoveries in the palace of Minos at Knossos, Crete, which 20 years ago startled the world with its revelation of an unknown civilization in the Aegean, antedating the classical Greek by a thousand years. The present volume, says Dr. H. R. Hall in *Illustrated London News*, deals with the relics of the early age, contemporary with the ancient and middle kingdoms of Egypt (B. C. 3500-1580) in Minoan chronology, from the Neolithic Age to the end of the Middle Minoan Period.

Though we have not reached the apogee of Minoan art in this volume, yet we see in it illustrations and descriptions of some of the most extraordinary, probably the most bizarre, productions of the Cretan workers, who at a period contemporary with the Pharaohs of the Twelfth Dynasty, were producing pottery of the most startling forms and colors, frescoes of strange naturalism and power, and architecture the most modern, including sanitary arrangements that were unknown in our own day till the middle of the nineteenth century. The designs of the pottery and wall-paintings, the costumes of the Minoan ladies and gentlemen as depicted by their contemporaries, should appeal to "modern" artistic minds.

Not least among the bizarre attractions of the Cretan palace and its architecture and art is the amazing fact that it is veritably a place of which we heard when young readers of the tales of Old Greece, and regarded as no more fact than the Brasail of the Irish or the Asgard of the Norse gods. It is the Labyrinth of the Minotaur, to which the tribute of the young men and maidens went from Athens to be devoured of the bull-devil; whence Theseus rescued Ariadne, and from which sailed back to Athens the black-sailed galley, which seeing, Aegeus cast himself despairing into the sea. This is the place of the labys, the double axe which was the emblem of its god; here the young men and maidens essayed the death-bringing sport (actual sport it probably was, as were the later Greek games and plays themselves) of leaping over the horns of the bull—to be gored or impaled, or saved by their own agility, as the case might be—in the courts of the Labyrinth of Knossos, which Sir Arthur has uncovered, that maze of courts and passages which caused the later Greeks who marvelled at it to give the name of "labyrinth" to any mazy thing, whether building or argument, net or coil of rope.

Minoan Furnishings and Fixtures

The Minoan civilization extended over thousands of years, and it is impossible to indicate here the different periods to which the above objects are severally assigned. Everything in volume I., however, is at least 3500 years old, and it is surprising how "modern" some of them seem, notably the bath, the draughts-board, and the marble cross. Of the latter Sir Arthur writes: "The occurrence of the cruciform stellar design as a symbol of the great Minoan Goddess under her Chthonic aspect, in the shape of amulets and small inlays, is in accordance with widespread parallels. But the discovery of a marble cross of the equal-limbed Orthodox Greek shape . . . is a unique phenomenon." The floors and altar-ledges of Minoan shrines were strewn with sea-shells and pebbles, marking "the religion of a people accustomed to look towards the sea" for livelihood.

The publication of "The Palace of Minos" lends especial interest to the photograph (by F. Boissonnos of Geneva) of the great corridor of the storerooms in the palace at Knossos, the center of the Minoan civilization. Describing the part of the palace shown in the photograph, Professor George Nicole writes: "Quite near to the entrance of the palace there is a large gallery, or corridor, running north and south. On one side is a series of openings leading into what were magazines or storerooms. The steward of Minos had placed in these magazines big jars of clay ornamented with zig-zag patterns and simple bands placed horizontally. They are of unusual size, some of them attaining two meters (6½ feet) in height. They were used to keep oil and grain . . . The decoration of the corridor consists in a painted frieze representing a procession of tax-payers loaded with divers provisions. One sees, also, a pyramidal candelabrum and many different marks of the masons, made to enable them to join together the different-shaped stones. Frequent among these marks is the double axe, which seems to have been the most popular sign. There is, perhaps, a reason for that, the double axe being a symbol of the religion of Crete. It is to be found on the sacred pillars, and it may be that it was this symbol which gave the famous name of "Labyrinth" to the Palace of Knossos; for the cult of the double axe was kept all through the classical epoch in the Asiatic province of Caria, where, in the dialect of the country, the word "labys" means the "double-edged axe." It was only later that the name of "labyrinth" was given to a puzzling disposition of roads or passages. On the other side of this corridor opens a magnificent central court, where Sir Arthur Evans constructed a belvedere to enable visitors to have a good view of the palace."

Photograph by Courtesy Metropolitan Museum of Art, New York

Swinging girl from earliest Knossos; the posts have been restored where the original ornamentation is omitted

Minoan Animal Sculpture

Among the most interesting relics of early Minoan culture found at Knossos was the bull's-head libation vessel (rhyton) which we are here enabled to illustrate by his courtesy, and by that of the Society of Antiquaries of London. With the exception of the inlays of shell and rock crystal, its material is of black steatite. It may roughly be described as about half the natural dimensions.

The greater part of the head itself was preserved, but a part of the left side and the left eye were wanting, also the horns and ears. The horns were fixed by means of square attachments, secured in each case by a pin inserted from the top of the head by means of a vertical perforation. This method corresponds, in fact, with the Minoan system of locking doors (illustrated by remains in the South House at Knossos) by means of a metal pin pushed through a "keyhole" in the wooden bolt.

We may infer that this type of vessel was designed for libations. The classical term "rhyton" belongs, strictly speaking, to a late class of vases terminating in animals' heads, made use of at banquets. Owing to the analogy in form, due to the perforation at the animal's mouth, the word has been very conveniently applied to this Minoan class, the religious intention of which can hardly be doubted.

Long hairs are engraved falling about the forehead, brows, and cheeks of the animal, showing that he was of a shaggy breed. Certain incurved, angular designs, moreover, on the forehead, the sides of the head, and neck, are evidently intended to indicate colored patches, resembling those seen on some of the painted designs of bulls. That over the forehead is very symmetrical, and somewhat suggests a Minoan shield. It is possible that it is a religious symbol.

Great corridor of the storerooms in the Minoan palace

A Curious Cretan Figure

In our own Metropolitan Museum of Art in New York are some interesting reproductions which seem to bring this far-away civilization almost to our doors. Among them is a little terra cotta figure, which is charming even as a fragment, headless and armless. She is neither standing nor sitting, but clearly in the attitude of someone supported on a swing; there is a transverse hole through her hips, through which a string or stick could be passed, and two supports crowned by doves found not far distant may well have been used for the posts. M. Gilliéron has reconstructed the group accordingly, supplying the figure with arms for the purpose. The girl has long, curly hair, and her simple, apron-like dress is in marked contrast with the elaborate garments with which we are familiar in her elders. Very lifelike is the way she holds her little feet close together in her effort at balancing herself. It is scenes like these that make us feel our close kinship with the Minoans of three and four thousand years ago. In costume, headgear, and action the representation might well be of a child of today. Only the doves on the posts may hold a meaning we no longer understand. With us they would be purely ornamental; have they here, as in the Mycenaean gold altars, a religious purport?

Excavations at Sardis

Early last April a group of American archaeologists, headed by the late Dr. H. C. Butler of Princeton, left for Asia Minor to excavate the site of Sardis, capital of the ancient Lydian Empire, home of Croesus, famed for his enormous wealth. Dr. Butler uncovered the great Temple of Artemis at Sardis before the outbreak of war in 1914. Little is known of the history of Lydia, except what is told by Herodotus. It was far famed throughout the ancient world for its wealth—a wealth then attributed to the gold of the river Pactolus, but now believed to have been due to the superior opportunities of the country for trade. Dr. Butler believes that the site of Sardis will yield great treasures of ancient art, relics and monuments throwing light on dark chapters of the history of the races about the Mediterranean and their early relations with the first civilization in the Valley of the Tigris and Euphrates. The site to which Dr. Butler held the title is about the size of Manhattan from Twenty-third Street to the Battery.

Palestine Explorations

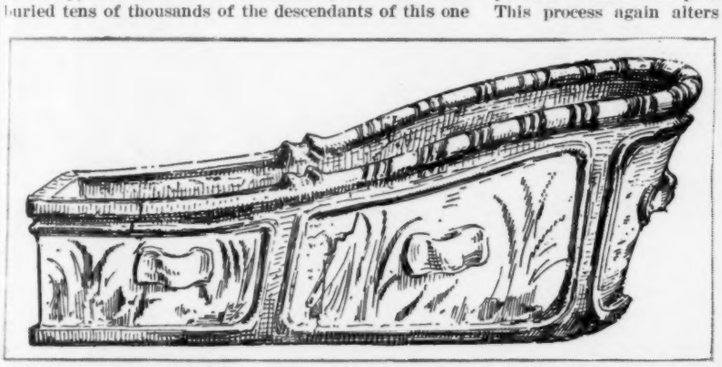
Under the direction of Dr. W. F. Albright, director of the American School of Oriental Research in Palestine, the excavation of Tell El-Ful, two miles north of Jerusalem, has been begun. In a few days, it was said in the announcement, Dr. Albright came upon numerous remains from the seventh to the third century, B. C., and has uncovered two ancient towers, one dating back to the Canaanite period, the other to that of Solomon.

Ptolemy Speaks From the Past

At Thebes, the ancient capital of Upper Egypt, archaeologists from Pennsylvania University have found demotic, or common-language, papyri that fill a gap in history from B. C. 309 to 246. This period includes the reign of Ptolemy Philadelphus, who was so successful in levying heavy taxes with a minimum of injury and dissatisfaction. As the manuscripts deal mainly with financial affairs, our own Ptolemies may perhaps learn from them how to create in us a nation of cheerful givers.

China's Kingdom of the Dead

In a gorgeous temple at Chu'u-fu sits the royally-robed figure of Confucius; about him stand statues of his chief disciples; extending into the distance is a cemetery, 13 miles in circumference, in which are buried tens of thousands of the descendants of this one man, Confucius. For 2000 years this cemetery has been growing, and it is today perhaps the most wonderful graveyard in the world. Confucianism represents the ideals of the ancestor-worshipping feudal aristocracy. Some 40 miles north of the tomb of Confucius is T'ai Shan, the holy mountains so closely connected with Taoism, the creed of the common people. Shantung is, indeed, the Holy Land of China, impregnated with significance for the swarming millions of the Celestial Empire.



A bathtub of painted clay, 4½ feet long, from a Cretan house of some four thousand years ago

Summer Foods in the Winter Time

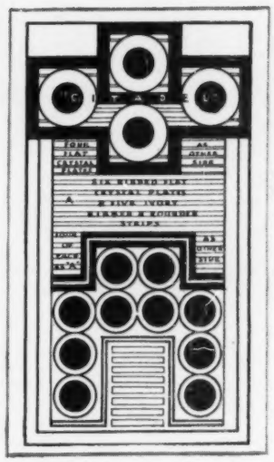
THE story of Joseph and his Brethren reminds us to prepare in times of plenty for the lean years that might come. The time is past when foods were eaten only when they ripened. Today strawberries and apples, grown in temperate regions, can be so treated that when they reach the torrid or arctic zones they can be brought back to their original condition easily and when eaten have the same full flavor as in their original state. The season of the year is no longer a determinant factor in deciding what fruits or vegetables are available for consumption, nor is the distance from the place at which the food was grown or prepared of consequence.

From times immemorial food was dried or treated in other ways for use in times of scarcity. All ancient peoples dried their foods on a large scale. This is perhaps the simplest process of preserving food, but it produces changes in the odor, taste and appearance of the food, which are noticeable to all who partake of them. Then again not every food is suitable for drying.

Bull's-head libation vessel, typical of early Cretan art and artisanship

The next oldest process of treating food is the salting process. This is used particularly with meats and fish. This process again alters the food materially. The great danger lies in either undersalting or oversalting. Undersalted food spoils and oversalted food does not taste like the original products. Another process uses vinegar and is known as pickling. Olives, cucumbers, various vegetables and certain meats and fish are familiar in the pickled condition. Smoked meats and fishes do not taste like the original foods at all.

Modern science has developed the art of refrigerating foods, which has revolutionized the meat and egg industries. This process has enabled the concentration of food producing plants at most advantageous sites and the shipment of the food across continents and oceans without danger of its deterioration. It has made it possible to store foods in their original condition and render them available at times of the year when they cannot be produced fresh. This modern method of preserving food has one great advantage over all the other methods mentioned, and that is that the food is not changed from its original state. The general appearance of the cold storage food is like that of the fresh article. Under certain conditions, when the storage is not prolonged, even foods of delicate flavors are preserved in their original state.



The Cretan version of draughts was played on this board

Still another typically modern development is the canning of food. When this is done under proper conditions, the food is preserved perfectly. But, there are numerous chances of improper canning with its resulting dangers. One disadvantage of canned goods is their high cost and another their limited keeping qualities.

During the recent war, the importance of being able to preserve food properly became very evident, and great impetus was given to the method of accomplishing this, known as dehydration of foods. This consists in slowly removing the water from food, so that the food does not alter its color or taste and its cellular structure is not impaired. The dehydrated food will absorb water again and swell up, assume its normal appearance, original odor, color and taste. The process is not so very new, its first application being in 1850 in France, but its real value was appreciated fully for the first time from 1914 to 1918. This is claimed to have preserved the German food supplies. It is why we were able to ship such huge quantities of food across to Europe in such short space of time. It must be remembered that nearly 75 per cent of all foods is water, and this water takes up space and is heavy. Dehydrated foods taste better and are superior in every way to foods preserved by any other method. They keep indefinitely.

The Ascent of Sap in Trees

NATURE for April 29, 1922, has a summary of the very interesting results obtained by Sir J. C. Bose, at the Bose Institute, Calcutta, in the investigation of the phenomenon of the ascent of sap. It is shown that the ascent of sap is a process of physiological activity dependent on the pulsation of living cells. This process is arrested by the action of poison, either in entire plants or in cut shoots. The active pulsating cells are not confined to the root, but are continued throughout the stem. It has been ascertained that, *e. g.*, in the stem of dicotyledons, these cells constitute the cortical layer which abuts upon the endodermis.

The velocity of the ascent has been determined by three independent methods, which give concordant results. The ascent takes place in plants even in the complete absence of transpiration. In "varnished" plants this velocity has been found sometimes to be as high as 70 meters per hour.

The cellular pulsations have been investigated and their characteristics determined from automatic records; they consist of alternate contractions and expansions. The direction of propulsion is determined by the phase differences of the adjacent cells. The velocity increases with the wave length of the propagated impulse. This wave length is determined experimentally from definite points of electric maxima and minima. Enhancement of velocity is associated with corresponding increase in the wave length. The enhanced rate of ascent is also attended by the increase of amplitude and frequency of cellular pulsations.

Ascent of sap depends upon cellular pulsation in tall trees as well as in herbaceous plants. There is, however, in the former the special adaptation of the woody tissue which serves as a reservoir to meet the excessive demand for water in the season of active transpiration. When this reservoir is more or less depleted, the phenomenon of "negative pressure" is manifested.

The New Conservation—II

Simplified Practice, and What It Means to Manufacturer and User

By Ray M. Hudson

Division of Simplified Practice, Department of Commerce

WE WANT what we want when we want it! This sounds rather complex, doesn't it? But as a matter of fact it is a very simple statement of a fundamental characteristic of human nature. It is an expressive Americanism, for it is our boast that we have not only a greater variety of wants than any other nation, but what's more, we have the means of supplying them.

The simple life of our forefathers, considered in terms of the modern conveniences, appliances and what-not with which we fill our homes, our workshops, and our temples of music, art, science, and religion, was a crude sort of life. "They didn't know what life was in those days." But we can't be too sure of that. Sometimes—especially at moving time—we wonder where it all came from. The accumulation of an infinite variety of articles for our several purposes is not at all difficult, nor is the investment in the articles hard to understand, for we feel we have something to show for our money. The amazing, and the amusing, part of it is we do not sense that all this variety in commonplace things is unnecessary to satisfy our wants, or needs. Not that we can get along with less articles, nor is it even hinted that we try, but we can manage very well with less variation in many of the things we use.

ONCE upon a time there were over 150 different styles of electric-lamp sockets. In buying a new bulb it was almost necessary to take your socket out and carry it to the store, to be fitted with a bulb. Today a lamp bought anywhere fits, automatically, a socket bought anywhere else. Not alone has the consumer, in the end, been vastly convenienced by the elimination of useless variation; a heavy saving in manufacturing costs and a huge reduction of capital tied up in dead stock has meant a substantial saving, as well—for the consumer and for the nation as a whole. In the present article, the second of a series of three, Mr. Hudson develops the angle of conservation of which this lamp item is one example. Preliminary impressions that he might be making a mountain out of a mole-hill will disappear in the light of the showing which he makes.—THE EDITOR.

Imagine how much worse it would be today if no two communities had a common system of weights and measures. It isn't so long ago when some very highly educated men were arguing the pros and cons of railroad gage. Today we get in a Pullman at Boston and leave it at Los Angeles. If we couldn't do that, we would raise an awful row. We don't have to turn the pages of history back any further than the late nineties to find that an electric lamp bulb was made with over 150 different sizes of base, and those men who tried to invent universal adapters were regarded as prophets without honor in their own country. Gradually, with the spread of the light of Edison, came a broader spread of the light of reason, and now we have one common base for all electric bulbs, and one bought in Seattle will screw into a socket in Atlanta.

It is said "times, conditions and methods change," and therefore the only true constant we know is "change." But, it is through change we measure our progress, and the advance of civilization. For years past, manufacturers have acted in the belief that only through variety in their products could they meet competition successfully. The increasing use of electric lights, of telephones, of automobiles, coincident with the world-wide distribution of these conveniences, reflects the principle that the more commonly a thing is used, the less need there is for variation in the physical dimensions of the thing itself. It is the service rendered that counts—the utility of the article. The more fully the article performs the function or service for which it is intended the more widely it will be used. Thus is standardization born, for the creation of the supply to meet the ever-increasing demand requires mass production. That, in turn, calls for the division of labor. The relatively complex process of manufacturing taken as a whole, is resolved into a series of minor operations which, when performed in proper sequence, result in a product of higher quality, greater durability, reliability, and service.

Simplified practice is merely the practice of simplifying things. It's not a new idea. Each manufacturer of a specific article is continually working to simplify his particular product, or the processes of its fabrication. But when you count all the manufacturers making a common article you get the mass-effect of too much variety. Think of the variety in automobile tires—diameters ranging from 30 to 48 inches; cross-sections from 3 to 12 inches, and tread patterns of every conceivable design. Of course, certain sizes and styles predominate and possibly 80 per cent of the total production occurs in 20 per cent of the varieties, but the question arises: Are all the other 80 per cent of the varieties necessary? Should the consumers of the 20 per cent have to pay for all the slow-moving lines—the losses due to their obsolescence—the interest charges on the investment in this dead stock—and also for the deterioration in the goods themselves? This is merely one example—there are hundreds of others.

Manufacturers of paving brick felt they had to have 66 varieties, each one differing from the other in its dimensions. This presented a problem for the highway engineer when writing his specifications for brick pavement. After conference of all interested parties, this variety was reduced to 11; a few months later this number was reduced to 7, and the possibilities are good for getting down to one standard size.

For years past the manufacturers of common brick have advocated one single size, and so have the makers of architectural or "face" brick—but casual review shows that even the humble brick can be varied infinitely in size, to say nothing of the possible variations in shape, form, weight, composition and color. And, as we think of the ultimate purpose of brick, we wonder whether a brick house is made any more serviceable or durable by these eighth and quarter inch differences in length, width, and thickness.

Turning our thoughts to the furnishings of the house, we find we can choose a bed from only two major classes, *i. e.*, wood and metal, but to compensate, as it were, for that narrow range of selection, we are offered over a score of different styles with varieties of size in each, covering a vastly greater range than that offered Miss Goldilocks when she called at the home of the Three Bears. Our furniture merchants have outdone those of her day by several hundred models. But of that, more anon! Selecting a bed is a fairly easy matter—the real problem begins when you try to find springs and mattresses to fit it. No stretch of the imagination can ever visualize the time and energy consumed per year by the great American public in trying to solve this problem. But some alert minds in the industry sensed that many advantages to manufacturers, merchants and consumers would come if these essential items of household comfort were harmonized in dimension. And by a unanimous agreement of all concerned, we now have one standard length, and four standard widths for beds, with the assurance from the manufacturers that they will hold to those standard dimensions and thus permit the spring, and mattress, makers to produce their goods in sizes that will fit.

The blanket manufacturers caught on to the idea and said, "We'll follow suit, for now that we know what sizes will be staple, we can manufacture those sizes the year round, and thus cut down the losses we now take on large inventories resulting from too many different sizes."

Have you ever noticed the tremendous variety of things for sale in a hardware store? Next time you go in, ask the salesman how many different kinds of saws there are, and the sizes in which each is made. Get him to tell you about his stock of hammers, axes, hatchets, files and wrenches. Then compare his answers with these facts, taken from manufacturers' catalogs.

Ordinary nail-hammers, as made by seven prominent American manufacturers, are offered in ten different types or patterns. Any one of these can be bought in from 1 to 3 different finishes. Three firms making handsaws having the same style of teeth offer them in 13 different sizes, but with variations within each size range from 1 to 16. Their cross-cut saws, with all styles of teeth considered, can be purchased in 21 different sizes, but with variations in each size range from 1 to 19. Considering the larger type known as "one-man cross-cut," we find there are eight distinct sizes, having within each nominal size-classification from 1 to 21 variations. Taking then, differences as stated, your hardware man has the option of selecting his stock from the following variety:

Manufacturer	Hand	Cross-cut	One-man Cross-cut
A	291	407	98
B	294	937	165
C	86	...	72

And very likely no one of A's products can be confused with one of B's or of C's, for each manufacturer invariably stamps, or labels, or otherwise marks his goods to prevent such happenings.

Axes are even more startling for they can be purchased in nearly a million different models, grades, sizes, finishes, and brands. It doesn't seem possible that the tools through which George Washington and Abraham Lincoln have been given so much publicity are susceptible to so much refinement, but consider for a moment that three manufacturers show in their catalogs 34 different types of single-bit axes. Each type is offered in 1 to 4 grades, 5 to 19 sizes, 1 to 11 finishes, and 1 to 35 brands. It is an easy problem in arithmetic to deduce that the maximum available variety in this article is $34 \times 4 \times 19 \times 11 \times 35 = 994{,}840$. Not very far from 1,000,000 is it?

Of course, they don't make as many as that, but if your order is large enough you can get any style, in any grade, size, finish, and brand you want. Actually these three manufacturers carry in stock only 6,118 varieties. It would take a fair-sized museum to house an exhibit made up of one of each in that number.

Men like to talk about the absurdity of styles in women's clothes, and hats, and shoes. But, if the women knew the truth about the styles or varieties

(*Continued on page 71*)

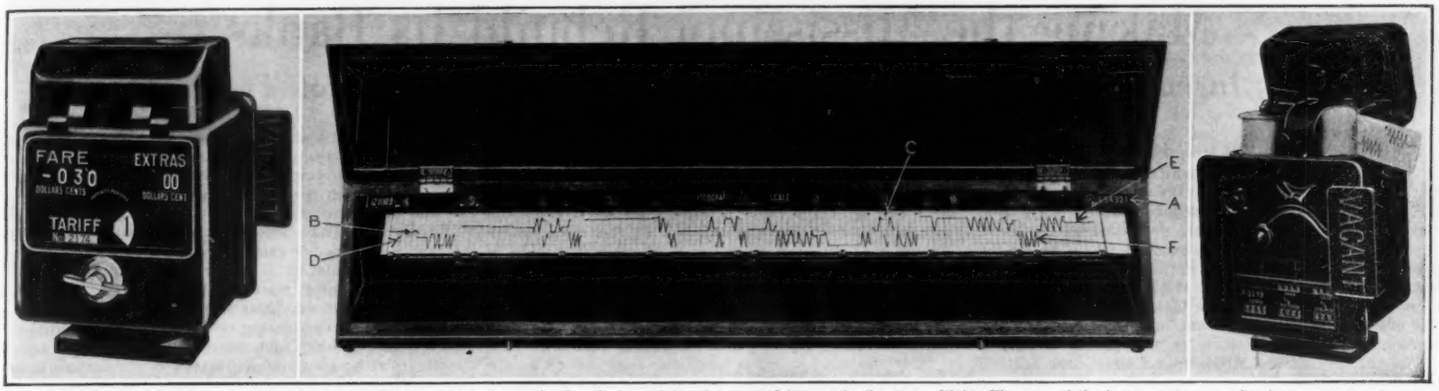
SIMPLIFICATION

APPLIED TO RAILWAY FREIGHT CAR CONSTRUCTION

PART	TYPES IN 1882	TYPES IN 1921	VARIETIES ELIMINATED
AXLES	56	6	89 %
JOURNAL BOXES	58	6	93 %
COUPLERS	26	1	96 %
BRAKE SHOES	20	1	95 %
BRAKE HEADS	27	1	96 %

ACHIEVED BY MASTER CAR BUILDERS' ASSOCIATION, NOW INCLUDED IN MECHANICAL DIVISION, AMERICAN RAILWAY ASSOCIATION; TO REDUCE COST OF CONSTRUCTION AND MAINTENANCE; ALSO TO BROADEN SERVICE THROUGH PROVIDING FOR INTERCHANGE OF TRAFFIC BETWEEN DIFFERENT ROADS

What simplified practice has meant to the builder of railroad cars, and to the railroads in handling them and keeping them in order



Left: Front view of the instrument, closed. *Center:* Typical record of a day's cruising, interpreted in part in the text. *Right:* The rear of the instrument, open, showing arrangement of the tape

The mechanical Sherlock Holmes that checks up on the irresponsible taxi-driver

On The Trail of the Taxi Driver

By Gilbert I. Stodola

HERETOFORE the taxicab operator has had no check on the driver and no way of knowing when the latter was wasting time or using it for his own purposes. While on the face of it this seems mainly a matter of concern to the company operating the cab, it is nevertheless also of considerable importance to the taxi-riding public, since taxicab tariffs, like the charges for many other kinds of service, are based largely on the expense of operation.

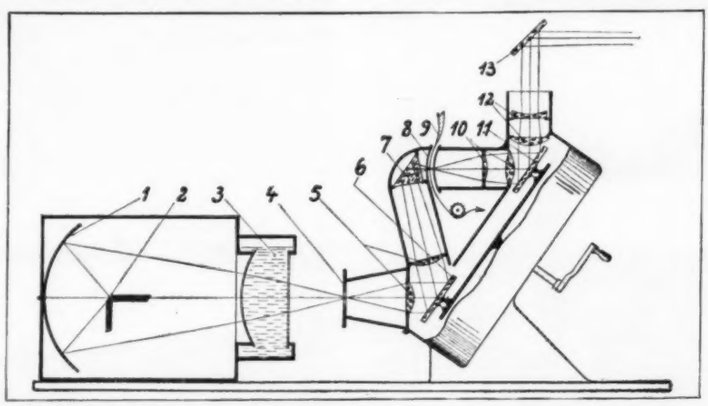
The new mechanical taxi detective, however, makes it impossible for the driver "to put anything over," for it gives a most detailed record of every movement of the vehicle during the entire time it is out. It not only furnishes all the information supplied by the ordinary taximeter, but shows in addition the starting and finishing time of each trip during which passengers were carried; likewise the mileage covered, the speed of the vehicle at any specified time, the number of stops made during each particular trip, and the duration of each stop. The record covering the cab's movements while it is not carrying passengers is equally complete.

All this is accomplished by a simple but ingenious mechanism, which consists essentially of a clock movement, a roll of specially-prepared recording paper, and two marking pencils. The sapphire points and will last indefinitely. The latter have The roll of paper, however, must be renewed periodically.

The paper tape moves forward past the recording pencils at the rate of about two inches of paper an hour. The pencils are directly over the tape and the mechanism which operates them is connected with the mileage shaft of the taximeter. Consequently when the cab is standing still the pencil will make a horizontal line on the tape, whereas the line made while the vehicle is in motion will be more or less oblique, depending upon the speed at which the cab is traveling. The pencils move completely across the tape while the cab covers half a mile; during the next half mile they move back again, and so on.

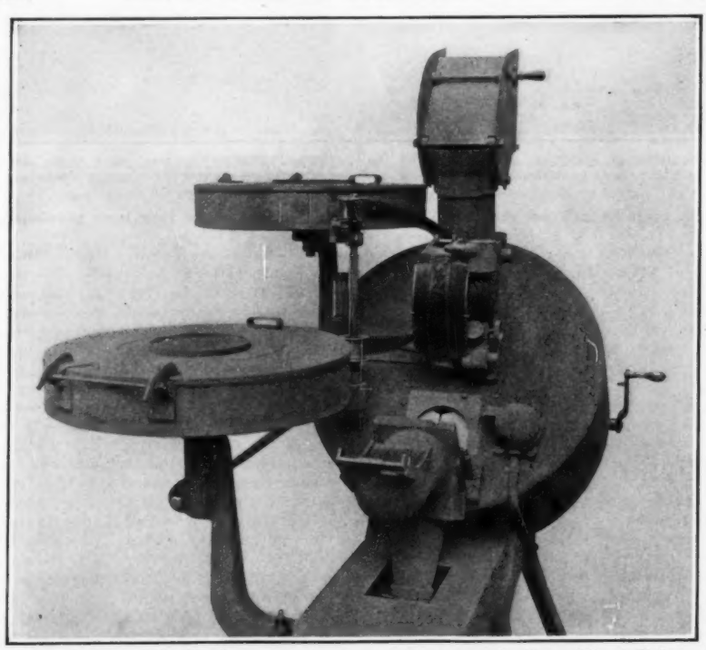
By means of a series of cams, when the flag is up, that is in the "to hire" position, the upper pencil alone is in contact with the tape. On the other hand, when the flag is down, and the taximeter is registering, only the lower pencil touches the tape. In the first case the record is made on the upper half of the tape; in the second instance it appears on the lower half. Small holes are punched in the tape margin when the meter is locked and when the flag is put down to start a trip.

An examination of the specimen of tape illustrated will make clear the method of interpreting the record. The hole punched in the lower edge of the tape at 8:06 shows that the mechanism was locked at that time. The cab started moving at 8:22, this being indicated by the beginning of the oblique line, and as this is in the upper half of the tape, the flag of the taximeter must have been up. After its start, the cab traveled 3⅜ miles, making only one stop, of two minutes. At 8:41 a passenger was taken on, indicated by the hole and the fact that the record jumps to the lower half of the tape. This passenger was carried seven-eighths of a mile and the trip finished at 8:47. The cab then traveled half a mile with the flag up, picking up another passenger at 8:50. The second trip was completed at 9:00 o'clock, the distance being 1⅝ miles, with several short stops. And so on.



In addition to the references given in the text, 3 is a water-condenser for the light rays, 6 a mirror and 7 a prism

Diagram showing operation of the new German flickerless movies



General view of the Mechau projector for continuous projection without flicker

The Flickerless Projector

By Dr. Alfred Gradenwitz

THE principal drawback of the cinema projector is the flicker, so far considered unavoidable. The film being carried intermittently past the projection window 16 times per second, a total of one-sixteenth second was available for each individual picture. The feeding of the film required one-fourth of this interval, while three-sixty-fourths of a second was left for the actual projection of each section of the stopped film. Now, the human eye will, with 16 intense light stimulations interrupted by as many intervals of complete darkness, feel a painful flicker.

Attempts to replace this intermittent motion of the film by a continuous displacement have been made for some time past. If a film be allowed to pass slowly through the projection window in a downward direction, the picture thrown on the screen will move slowly in an upward direction. If, now, a mirror swinging round a horizontal axis be inserted between the objective and the screen, the rate of rotation of the mirror may be chosen as to compensate the displacement of the film projection. If, next, a special mirror be provided for each individual film picture passing through the projection window, it will be possible to arrest each picture and hold it momentarily in the field.

This problem has been solved in a most satisfactory manner by E. Mechau, of Wetzlar, Germany. The beams from an arc lamp turned away from the projector, after being concentrated by a concave mirror, are thrown through a diaphragm and lens on the rotary compensation device, consisting of eight brackets and eight mirrors carried by these. Apart from the rotation of the system, each mirror in its joint performs a convenient swinging motion. This double motion draws the impinging beams of light along with the running film, and in addition compensates the displacement of the picture, which appears upon the screen, quite at rest and immovable.

The diagram will serve to illustrate this. The light coming from the arc lamp *2* is, by means of the concave mirror *1*, so concentrated as to produce in the diaphragm *4* an optical image of the source of light. After being made parallel by the lens *5*, the light beams are cast on one of the eight mirrors constituting the rotary system, thence on a reflecting prism and, through the projection window *8*, the film *9* and the lens system *10*, on the rotating compensation mirror *11*, and eventually, through the objective *12*, on the projection mirror *13*, whence they are reflected on the projection screen.

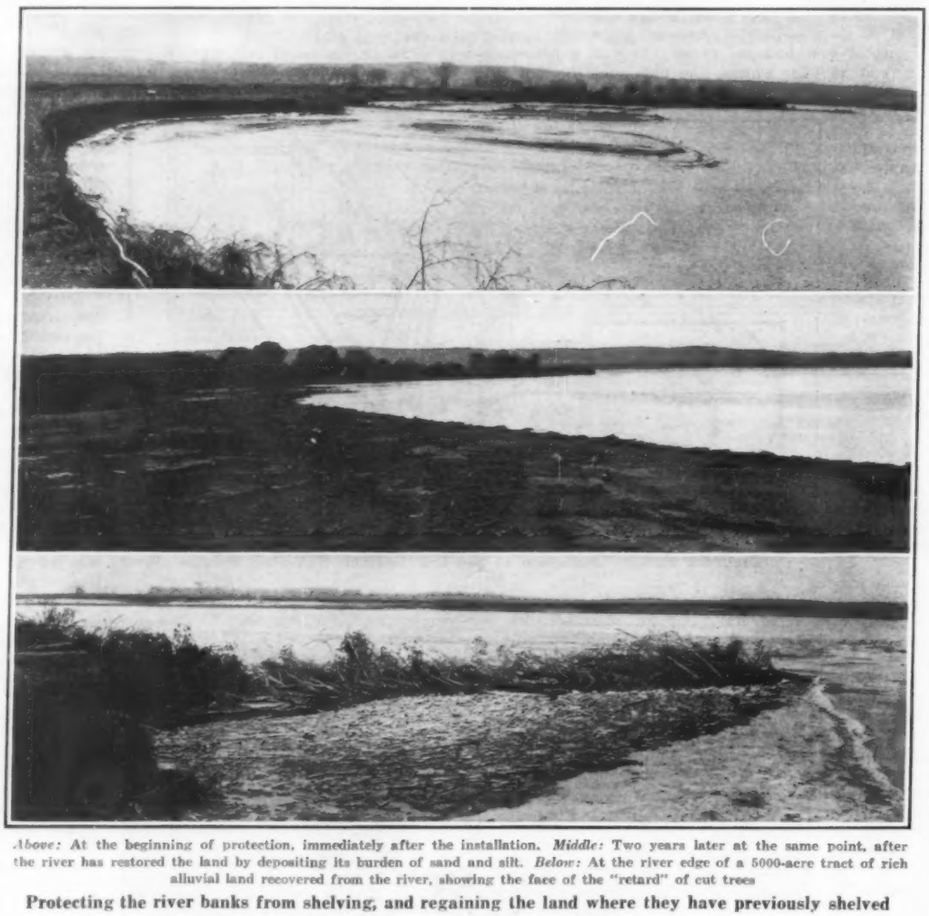
The general view shows another distinctive feature, viz., that the reels are arranged with vertical axis, thus placing the film on edge. The reels are thus prevented from weighing on the two terminal portions of the film, and, as in the case of the usual projector, giving rise to considerable wear and tear.

Making the Mississippi Rebuild Its Banks

Ingenious Method of Reclaiming Eroded Land by a Mat of Trees

ONE OF the most destructive effects produced by a river is the erosion which occurs when a bend throws the weight of the river against the outer banks. Where the substrata are of rock, or other non-erodible material, the wash of the river produces no appreciable results; but when, as in the case of the Mississippi, the river flows through a valley containing a deep layer of alluvial soil, the damage done by erosion is enormous. The banks being undermined, fall out into the river current, and in a state of suspension the rich material is carried down stream.

The farmers of the Mississippi Valley, and particularly those whose farms lie adjacent to the river, the railroad companies, and property owners in general have been engaged for many a long decade in a plucky and persistent fight against the encroachments of the mighty stream. Much of this work has been due to private initiative; but, of necessity, the bulk of the preventive and reclamation works have had to be done with the assistance of the Federal Government. These works have consisted, first of the building of lofty banks, or levees, designed to keep the river, even at the highest period of flood, within its banks, and prevent those vast inundations which periodically have caused an enormous loss of property. Another preventive work has been the construction of dikes extending from the banks out into the stream, and so located that they will either divert the current from the banks or slow it down to the point at which it will cease to have any serious eroding effect. Usually these dikes have consisted of piling driven into the bed of the river and sheathed and rip-rapped, so as to present a positive obstruction to the current, and at the same time prevent it from undermining and carrying away the whole jetty. In addition to arresting the flow of the current, and slowing it down to the point at which it ceases to have any eroding effect on the banks, these dikes cause the water to deposit the greater part of its burden of silt, thereby building up again the lands which have been eroded. All of this work is, of course, enormously costly, and many hundreds of millions of dollars have been expended in protective and reclamation works, both large and small, in the Mississippi Valley alone.



Above: At the beginning of protection, immediately after the installation. *Middle:* Two years later at the same point, after the river has restored the land by depositing its burden of sand and silt. *Below:* At the river edge of a 5000-acre tract of rich alluvial land recovered from the river, showing the face of the "retard" of cut trees

Protecting the river banks from shelving, and regaining the land where they have previously shelved

The present article describes a new system of bank protection and land formation, which performs the same duty as the pile dike, or jetty, and does it more effectively and at a greatly decreased cost. Essentially it consists of substituting for the jetty a group of young trees, woven into a mat anchored on the bed of the river, and extending out into the stream at the points where it is desired to prevent further erosion and rebuild the land which has been washed away. The tree mat is firmly bound together and is anchored in position with the trunk of the trees up stream. It is held against the rush of the current by a series of cables, which are lashed around the tree trunks at their up-stream end, led up stream for a hundred feet or so, and anchored to special armored concrete piles, which are sunk by the jet method, so deep into the bed of the river as to be beyond any possibility of being scoured and washed out.

The shorter lengths of concrete anchor piles are of the type shown in our illustration. A four-inch pipe runs down the center of the pile, with branches leading at intervals from this pipe to the outer face. The piles are taken out into the stream, and sunk in place from a steam derrick lighter. Attached to the water pipe within the pile is a length of pipe, to the upper end of which a flexible hose is attached. As soon as the pile has been lowered to the bed of the river, water is fed to it under a pressure of about 150 pounds to the square inch, and under its cutting action the pile can quickly be sunk to any desired depth. In the line drawing showing a pile position, it will be seen that its nose is on bed-rock, 76 feet below the surface of the river, and some 60 feet below the river bed.

Now the tree mat acts with the same effect as the very efficient brush dams, which were used so largely by the pioneers of America when concrete and cut stone for dam construction were not available. The interstices between the tree trunks and the branches rapidly fill up with sand and silt, until a practically impervious wall is created, just as efficient in arresting the current as the pile, or pile-and-rock, jetty.

It is a well understood fact that if a silt-bearing stream, carrying solid matter in suspension, be arrested or slowed down, the solids will be deposited roughly in inverse proportion to the velocity of the current. It is this law which acts so disastrously in the formation of sand bars in navigable rivers, as one may at any time see for himself. Should some large tree trunk, or other debris, ground upon the bottom of the river, the local arresting of the velocity of the stream results in the depositing of the suspended solids, and a sand bar will sooner or later be formed. Now the tree-mat construction, which is the invention of the Wood brothers of Lincoln, Nebraska, avails itself of this law, and the mats which have been put in position have proved to be highly effective, not only in preventing further erosion of the banks, but in rebuilding areas of land which had been cut away. We present three photographic views, the top view being a close-up of a tree mat, and the other two more distant views embracing the devastated land and showing how, after an interval of time, ground had begun to rebuild itself in the slack waters created by the obstruction. The middle view of the three is interesting as showing the gradual formation of shoals in the eroded bay.

The operating company has already put into force "Standard Current Retards" at 25 points along the Missouri River. Organization of districts for protection from inundating rivers are now in process of formation in Missouri which will involve the expenditure of an aggregate of $1,000,000 for the introduction of this system of disciplining refractory rivers. Estimates have been requested and contracts are now in formation contemplating adoption of this protective feature in the Mississippi, Rio Grande, Canadian, Platte, and Sacramento Rivers. Thirty-one levee districts are being organized in South Dakota, Iowa, Nebraska, and Missouri.

A railway company was the first enterprise to apply this newly-devised system of protection against insidious waters. After spending millions of dollars a transportation company operating through Gibson, Nebraska, successfully established a safeguard against invading waters for its valuable freight property at this point. The Burlington Railway Company has adopted this form of water insurance, expending $200,000 for the purpose during 1921. The Illinois Central Railroad Company has approved the "Standard Current Retards," as it is called, and obtained insurance for its double-span draw bridge at Omaha, as well as protection for its threatened right-of-way north of Council Bluffs. The expensiveness of guarding against the eroding influence of streams to railroads, by methods previously employed, is emphasized by an instance on record of one company having invested $2,000,000 in protecting a three-mile stretch of right-of-way.

The company controlling the patent rights of the new system, claims that for the first time in the history of the river, a system of bank protection has been devised which is economical enough to warrant its use in the protection of farm lands. Three years ago they purchased 2300 acres of rich bottom lands in Fremont County, Iowa, which were being rapidly eaten away by the river. These lands, all in cultivation and with fine improvements, were purchased for but a small fraction of their real value because of the fear of the river. This system of protection was installed, the lands saved, and an additional strip of accretion lands have been developed almost equal to the original purchase.

The procedure of engineers supervising the construction of this form of insurance against waters of devious ways is to survey the area, extend frequent lines of soundings across the river, and chart the currents above the initial point of erosion. Having this information in their possession, a series of retards is planned. The beginning is marked where the channel first turns and the retards are spaced at such intervals and lengths, as well as direction, as may seem feasible to afford complete stoppage of the cutting, and to invite the maximum volume of silting or development of accretion land around the miniature forest projected in the river. Five powerful tug boats, fourteen operating barges, a large group of bank hoists, and caterpillar tractors are the implements employed by the construction company in disciplining rivers whose waters are uncertain and frequently unruly in their habits of flow. Two million dollars worth of "Standard Current

Retards" were installed for railroad and levee districts along the Missouri River in 1921.

When Alaska Forest Rangers Travel by Motor Boat

A FOREST ranger who rides a motor boat instead of a horse would be a novelty in the Western States, but is the rule in the Tongass National Forest, Alaska. In a report to the United States Department of Agriculture, of conditions there, E. A. Sherman, associate forester, writes as follows:

"The Tongass National Forest is completely equipped with an admirable system of waterways. Here, instead of saddle and packhorses, the ranger rides a seagoing motor boat. He guides his steed by means of a wheel instead of reins; feeds it gasoline instead of oats; tethers it at night with an anchor in some sheltered cove instead of with a picket rope in a mountain meadow, and uses the paint brush in lieu of a curry-comb."

Rangers in that national forest travel in couples, two men to each motor boat. The boat is a stanch, sea-worthy craft, 35 to 40 feet long, equipped with 25-horsepower engines, and with fully inclosed cabin and pilot house. Except when they are at headquarters or actually at work in the woods, the rangers eat, sleep and live on their boats.

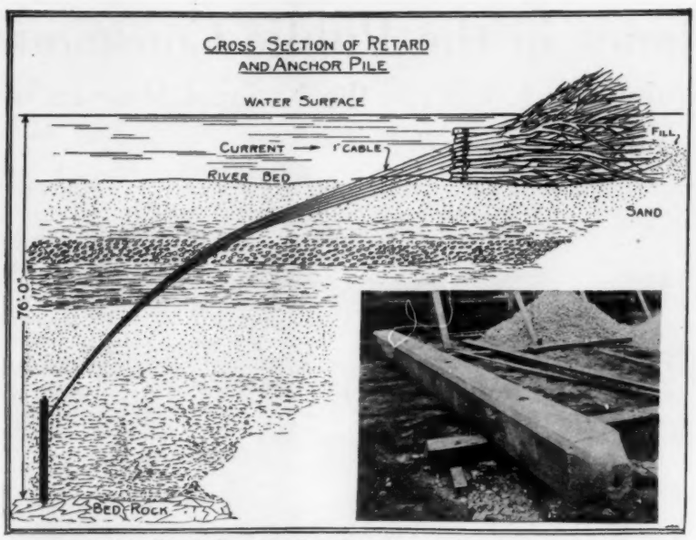
"Summer is the busiest season," Mr. Sherman reports. "Their day is not an 8-hour day, but usually a 16- or 20-hour day, with only one man actually on duty while the boat is running. The ranger is just as proud of his boat as the Bedouin horseman is of his steed, and the ranger boats in Alaska are the most distinctive craft sailing the waters of the Alexander archipelago."

The Life-Cycles of Bacteria

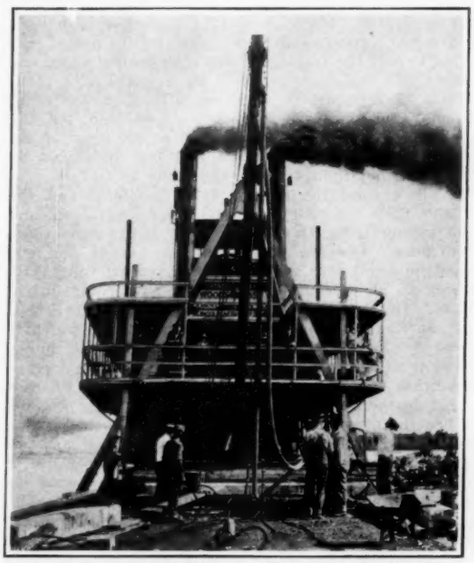
IN a recent publication of the National Academy of Sciences Dr. F. Lohnis describes the life-cycles of bacteria. Briefly the life cycle is as follows: Under certain conditions the cells come together and fuse, forming an amorphous mass—the symplastic stage—in which the protoplasm undergoes a thorough mixing. The symplastic stage is formed not only in cultures in artificial media, but, in the case of the pathogenic organisms, in the body of the host as well. It forms the connecting link between the various sub-cycles of which the life cycle of the organism may be composed. All kinds of vegetative cells, as well as all the varieties of reproductive organs described by the author, can give rise to the symplastic stage. From the symplasm the so-called regenerative units always arise and these either grow into new cells or several of them unite to form new cells directly.

Six distinct types of reproductive organs have been described by the author. These are: (1) Gonidia, two to four or more in each cell. They are generally motile and slightly more resistant than vegetative cells. Many are filter passers. They grow into vegetative cells. (2) Regenerative bodies, distinct from regenerative units. They are spherical, oval, pear- or kidney-shaped or more or less irregular, rod-shaped and branched. They are readily stainable, generally motile, and fairly resistant. They may multiply by fission or budding, are formed from vegetative cells or from the symplasm, and may give rise to vegetative cells or to the symplastic stage. (3) Exospores, unstainable regenerative bodies. (4) Endospores, produced by vegetative cells or by regenerative bodies. Conditions for formation are similar to those for the formation of regenerative bodies. (5) Arthrospores, easily stainable, but withstand drying better than heating. They are formed by the segmentation of vegetative cells and transformation of the joints into fairly resistant spherical bodies. (6) Microcysts, very similar to arthrospores. They are formed by vegetative cells growing and becoming spherical with a thickened membrane. After a rest period they may become vegetative cells, germinate like pores, or may break up into two, three or four segments, which become vegetative cells. In addition to their reproductive function exospores, endospores, arthrospores, and microcysts are, in the first place, resting stages.

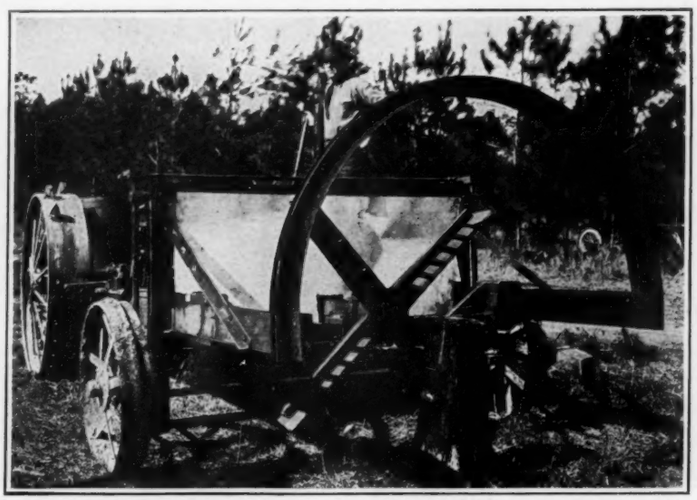
Besides the formation of the symplasm a second mode of interaction between the protoplasmic bodies in bacterial cells has been observed. This consists in the union of two or more cells, and is termed "conjunction" by the author. Conjunction is most common in cultures two to four days old, and generally precedes the formation of gonidia, reproductive bodies, exospores, and endospores. The publication brings together an overwhelming amount of evidence as to the existence of the various forms distinguished by the author.



A cross-section of a timber retard, and a view of the concrete pile by means of which it is anchored to the bed rock



Sinking the concrete piles to which the retards of cut trees are tied by steel cables



The stump remover that grinds the stump up into chips for the turpentine mill

Localized Radio Landing Signals for Airplanes

RADIO direction finders and other devices have been in use for some time to assist airplanes in landing during the night, fog, or at other times of poor visibility. The most usual method of employing radio for this purpose is to transmit from an ordinary elevated antenna at the landing field radio signals which are received on a direction finder carried by the airplane. Such a method gives the direction of the landing field but does not tell accurately the distance from the plane to the field.

Several years ago the Bureau of Standards was called upon to develop a method to assist airplanes in accurately locating the landing field when the airplane was close at hand. A method was desired which would give a signal heard over a comparatively large area when the airplane was at a high altitude but would be localized within a small area when the plane was near the ground. A method employing a large horizontal coil tuned to 500 cycles was tried but did not prove satisfactory. The use of radio frequency waves was, therefore, undertaken and two horizontal coils, one above the other, with current flowing in opposite directions, were used. A fairly high radio frequency, such as 300 kilo-cycles, was employed.

A calculation was made which indicated that the signals radiated from the two coils would be the strongest for an airplane flying in a given horizontal plane whenever the airplane was within a comparatively small ring-shaped area located above the landing field. The results of these calculations were verified in practice.

The Bureau of Standards has just published a paper giving the theory of the radiation from an antenna consisting of two horizontal coils such as that described above. The area within which the signal is heard, and the point at which it is most intense are discussed. The results of these investigations are given in Bureau of Standards Scientific Paper No. 431.

A Stump Cutter That Is Different

NOWHERE, perhaps, does the stump present a greater problem than in Louisiana. This state has something like nine million acres of cut-over pine lands, studded with stumps, about thirty to the acre for a fair average. These stumps have in many instances been there for forty years without showing any indications of rot; and they have resisted the attack of stump pullers and dynamite equally.

Sylvester M. Hurd, of Livingston Parish, owns what would be a handsome farm of 170 acres if it were not for the stumps. He has tried all the conventional remedies, and none of them will deal with the stumps at a practicable cost. So he has put his inventive mind to work on the problem, and has designed a stump remover that is radically different from any we have seen. It does not use explosive, it does not attempt to pull the stump; it simply chews it up. The cutter head, which weighs 3000 pounds, has four arms studded with heavy steel blades. At the ends of the arms are other knives placed so as best to cut into the ground. The contrivance can be attached to any tractor. Automatic devices lower the cutting head to the ground near the stump, and then move it slowly forward, while the cutting arms revolve at high speed. The above-ground part of the stump is literally chewed into chips, while at the same time a clean cut is made through the tap root eighteen inches below the surface, and the entire stump above this point included in the general mastication. The hole left is small compared with that left by blasting, and yet is sufficiently deep to permit of plowing. Then the chips are baled and sold to the turpentine mill, at a figure that goes a long way toward paying the costs of de-stumping. There might actually be a profit in the operation if it were not for the cost of delivering the chips to the mill.

Airplanes in the Public Consciousness

The Planes-in-the-War Exhibit at the National Museum in Washington

By C. H. Claudy

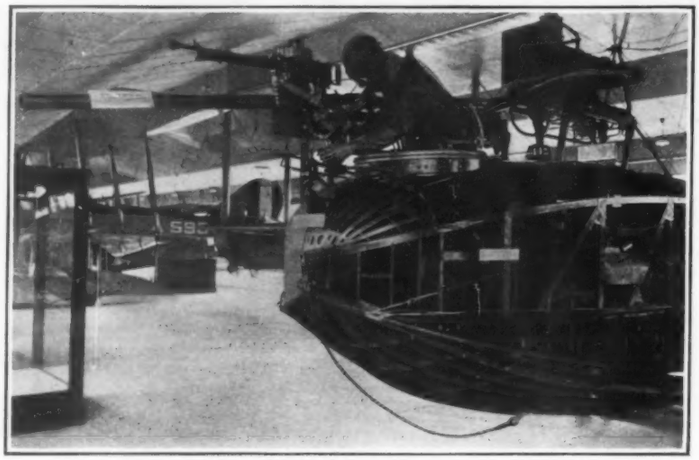
THE FUTURE of aviation in America is intimately bound up with popular education on the subject. The more people know of and understand something about the problems of aviation, the more likely that knowledge is to be reflected in Congressional action. Hence it must be considered that the airplane exhibit of the National Museum in Washington, recently opened to the public, is a distinct factor in the future of aeronautics, since nowhere else can so intimate and first-hand an acquaintance with the mechanical bird so readily be made. Hundreds of thousands of tourists visit the Museum yearly, and the effect of this elaborate exhibit upon them, arranged for easy comprehension, can hardly be over-estimated.

In the old Museum is the historical exhibit, with which this story is not concerned, except to note that both Langley's and Wright's original planes are there. It is the new or airplane-in-war exhibit to which especial reference is here made.

This collection, housed in an unsightly but commodious building all its own, directly to the west of the old Museum, includes eight planes of diverse types, so arranged and placarded as to answer the thousand and one questions which all thinking laymen want to ask about a plane as soon as they see it is something else besides the two wings and motor hum which alone appear to the observer when it is in the air.

On first entering the vast building, attention is immediately engaged by a flying boat, Model F 5 L, which was designed and used for patrol and convoy duty in the war zone. This monster plane has a wing span of 103 feet, 10 inches, is 49 feet 4 inches over all in length, and carries 495 gallons of gas, which at a speed of 100 miles per hour gives a cruising radius of 800 miles or eight hours flight. Fully loaded, the plane weighs 13,000 pounds and is kept in the air by two 400-horsepower Liberty engines.

The particular feature of this plane which makes it of such vivid interest to the visitor is that one-half of it is complete and the other half half-skeletonized, so that its construction, its interior, its controls, its mechanism, its available space and its fittings may be easily seen and understood. Every one knows that big planes like this are equipped with radio; here the visitor sees the apparatus, in the body of the fuselage, with a life-size model of a radio operator at work with his apparatus. Many know that the controls in such a monster ship are duplicate; here the absence of covering to half the fuselage shows both control seats, one empty and the other occupied by a model of a pilot. The F 5 L model is equipped with four 230-pound bombs. Not only are the bombs to be seen, but the mechanism which drops them, and at the prow of the ship is a bomber, using the sighting apparatus by which he determines where the bomb is to fall.



Prow of a flying boat, showing gunner using bomb sight

Walk around the mighty flying machine, and the visitor finds the door to a gunner's cockpit open, and the gunner using one of the three Lewis guns there controlled. Observe the wing edge closely and one sees the small pipe which, through venturi tubes, produces an air stream in the air-speed recording instrument. Here one can also trace out such small details as the Sandow attachment or Bungay cord which is used to aid pilots in keeping the plane on its course. That is, if one engine is damaged, the other engine has a certain turning effect which it is necessary to overcome by keeping the rudder in a constant position. When the attachment is stretched and attached to the rudder bar, the rudder exerciser maintains a constant pull. There is also a Sandow attachment for use in conjunction with the elevators in case the plane becomes tail heavy or nose heavy.

Another plane skeletonized for the edification of the student is a De Haviland 4, tractor biplane, which as most people know was developed in England and adopted by the United States for observation and bombing purposes. This particular one is equipped with a 400-horsepower Liberty engine, driving the plane at 120 miles per hour for 2.6 hours on a gasoline capacity of 94 gallons. Two Lewis guns and two Marlin airplane guns are its armament. Here, too, it is interesting to get a little intimate industry-in-war history. Examination of the bomb-sight shows it to bear a small copper plate which advises the curious that this piece of apparatus was made by the Edison Phonograph Works.

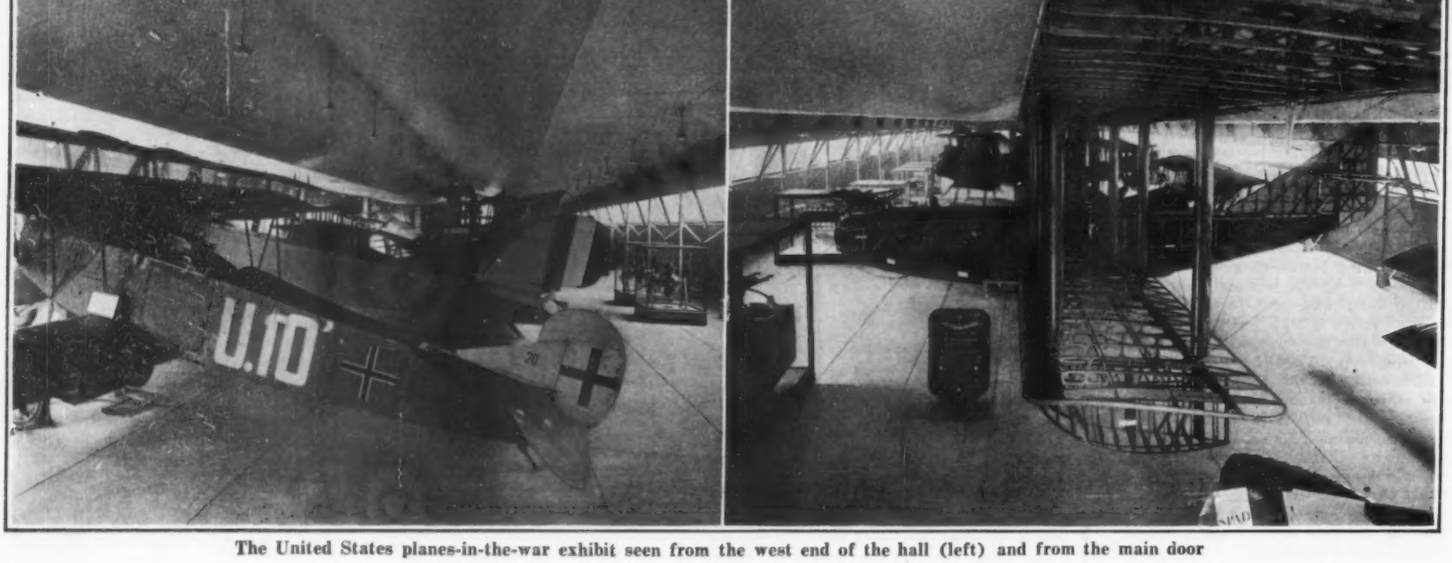
When it comes to bombing planes, however, the Marlin bomber holds the center of interest because of its huge size. Twin Liberties drive it 104.8 miles per hour, and 250 gallons of gasoline give it a 3¾ hours in the air. It has five Lewis guns and ten bombs.

The Museum authorities have combined historic with scientific and mechanical interest by illustrating types, in some instances, with planes which are not only examples of the kinds but which saw actual war service. Thus, the Spad, developed and used by France, is here represented by one, which if not actually that used by Fonch, Guynemer and Rickenbacker, at least saw good service in the great war. This particular airplane was part of 22 Aero Squadron Air Service of the A. E. F. It has seven victories to its credit.

On September 2, 1918, Lieutenant A. R. Brooks, on voluntary patrol destroyed an enemy biplane Rumpler, in the region of Thiacourt; September 4 he destroyed a monoplane Fokker in the region of Thiacourt; September 14 he destroyed two Fokkers over Mars-la-Tour; October 9 he destroyed a D. F. W. over Aincerville; October 27, Lieutenant Jones destroyed a Fokker over Champigneulles and on October 30 Lieutenant Jones destroyed another Fokker near St. George. Lieutenant Swaab, one of the Squadron aces, also flew this plane a number of times. By far the most interesting thing about this plane is the large number of little black crosses which dot it here and there, each one indicating a mended bullet hole. In addition there are a number of bullet holes which were never mended.

The Spad is equipped with a Hispano Siuza motor of 220 horsepower giving a flight speed of 135 miles per hour. The gasoline capacity of 30 gallons permits a sustained flight of two hours. The armament includes two Vickers machine guns.

(*Continued on page 72*)



The United States planes-in-the-war exhibit seen from the west end of the hall (left) and from the main door

The road-scraper showing its versatility by putting an ice surface in shape for the skaters

A New Principle in Plowing and Road Surfacing and Ice Surfacing

By E. M. Stevenson

THE photographs accompanying this article show a spiral plow and a road shaver invented by Mr. Lytle S. Adams of Webster Grove, Mo., who, backed by years of experimenting and research on his ranch in the Southwest of this country, is now placing these machines—and a stump cutter that employs the same principle—on the market from East St. Louis, Ill.

The plow is designed to give the soil all of the benefits of its own natural nutrition, Mr. Adams claims, which is not possible by any other methods of soil cultivation now in use. It consists of nine spiral cutters or blades, located in a triangular shape, each following blade covering the soil just missed by the one in front of it. Right ahead of the last blades are the rear wheels, allowing them to run on firm ground, while the following blades plow the soil after them. The machine leaves in its wake a twelve-foot swath of soil, pulverized to a depth of 16 inches, if desired.

Each plow blade is constructed like an auger and made of the hardest cutting steel. The entering edge is smooth and sharpened while the rest of the blade consists of sections of teeth, like a saw blade, bolted on to the drill shaft so they may be replaced when worn down.

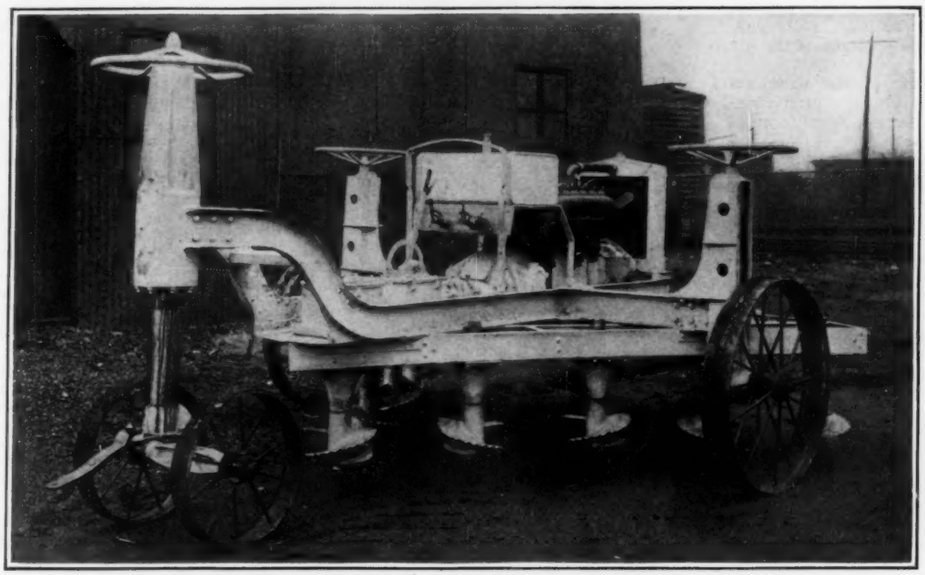
The blades are operated by a continuous chain, driven by a 4-cylinder, 45-horsepower motor. They revolve at the rate of 200 to 600 revolutions per minute, according to speed desired.

By reason of its alternate blades turning in reverse directions the plow will never clog in any soil; each blade has a tendency to clean the other. The revolving blades never strike an obstacle squarely, but with a rotary motion, so that the blade either moves it out of the way or shifts to one side itself. The plow may easily be pulled by a 10-20 tractor or, quite as readily, by six horses. Its own operation of blades revolving forward tends to cut its way through the soil, on the old principle of a circular saw, and is a distinct advantage as a cost saver in its assistance to the motive power.

The reason for the peculiar advantage of this plow beside the time and economic advantage in finishing the soil for seeding, lies in the fact that nitrogen, which is the most vital part of soil nutrition, is found in the roots of vegetation, and, by turning over and harrowing, the soil is only provided with this property about two or three inches in depth. Whereas, the Adams plow takes every bit of vegetation and fertilizer and mixes it thoroughly with an even distribution throughout the depth of plowing.

The rotary road shaver shown herewith is a machine built on the same lines as the spiral plow. The principal difference between them lies in the position of the rear wheels. On the plow they are just ahead of the last blade, so that the solid ground the wheels run on may be plowed after the wheels have passed; while on the road shaver the front wheel follows the first cutter and the rear wheels follow the last cutters, making possible a perfectly smooth traction on an evenly shaved surface of road. There are nine cutters, each driven by a continuous chain and rotating in reverse directions, alternately. Thus the cutters assist each other and prevent chipping of an asphalt surface by precluding too much pressure in one direction and making the machine more easily guided and controlled, which would not be the case, were the cutters allowed to rotate in the same direction.

This machine is designed primarily for use on an asphalt-paved street or road that has been worn considerably in places and is full of small bumps. With its nine cutters revolving at a high rate of speed the shaver leaves in its wake a swath of smoothly planed surface of road twelve feet in width. It is claimed that a street in poor condition may be made as good as though the paving surface had just been laid. In addition, it would be a matter of only a few hours to put a sheet of ice in perfect condition with this machine. Last winter the shaver was tried out for this work in Chicago, and gave better results that were attainable in any other way.



The spiral-cutter plow, showing the arrangement of the nine cutters

Soil Acidity Preferences of Some Eastern Conifers

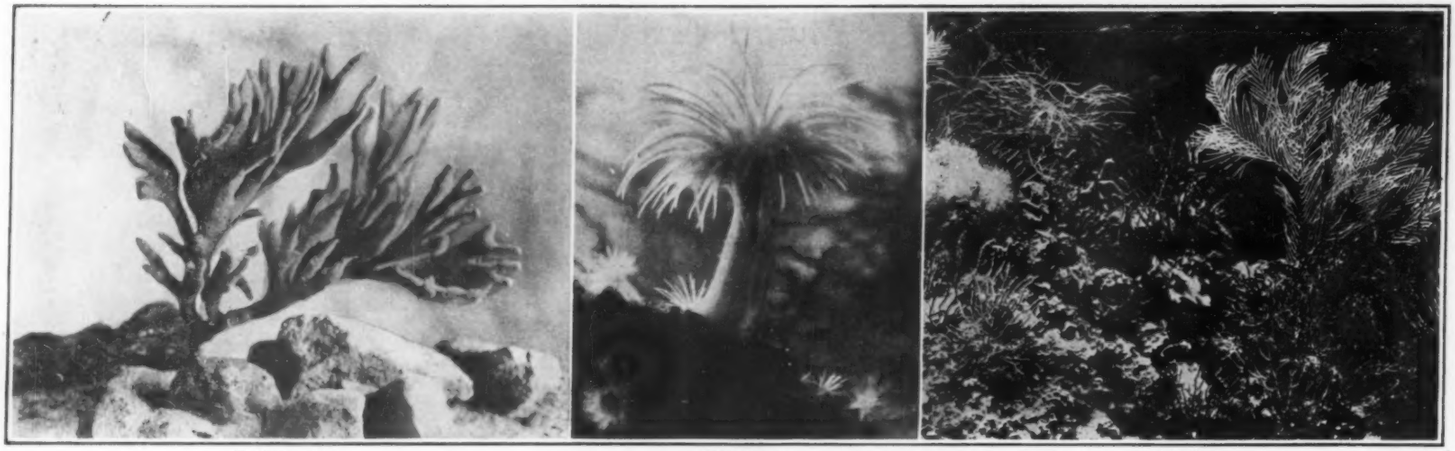
IN the *Journal of Forestry* for May, 1922, Mr. E. T. Wherry, U. S. Department of Agriculture, discusses the question of the Soil Acidity Preferences of Some Eastern Conifers.

Plants differ markedly in their response to acidity or alkalinity of the soil, some being apparently able to grow about equally well no matter what the reaction, while others are very sensitive in this respect, and die promptly when placed in a soil of unsuitable acidity or alkalinity.

The seeds of trees lodge and germinate in the upper layers of the soil, and so are affected only by the acidity conditions existing there; but as soon as the roots reach any considerable length, they may be subjected to totally different reactions. Since soil acidity is largely the result of the oxidation of cellulose and other constituents of the leaf litter, it is normally greatest at the surface and diminishes more or less rapidly in depth. Moreover, the leaching effect of rain, removing lime and other bases which might neutralize the acids as fast as they form, is greatest at the surface. In studying the soil acidity relations of trees it is therefore essential to note not only the surface acidity, but also that at some depth, so that an idea of what may be termed the acidity gradient can be obtained.

It turns out that three general habitat classes can be recognized, which may be termed respectively acid, intermediate and circumneutral. Acid habitats comprise such as exist, for instance, in the New Jersey pine barrens, where the surface soil is mediacid (specific acidity 1,000 to 100) over vast expanses. Here the acidity gradient is slight and at depths of a meter the reaction may still be mediacid, or at any rate subacid. Intermediate habitats may be superficially similar to the preceding, with mediacid reactions at the surface, but the acidity gradient is marked, and the acidity is decidedly lower at 10 cm. depths, while the soil is usually quite neutral before the depth of a meter is reached. Circumneutral habitats are those in which the surface material is only exceptionally more than minimacid. The surface may be neutral or even somewhat alkaline, and in any case minimalkaline reactions are shown within a few centimeters of the surface. Discussing his results Mr. Wherry says: "Of the 23 species and varieties of conifers studied more than half seem to favor the more acid conditions. In this connection it is interesting to note that most pines and their relatives are to be found in the acid groups, while the cedars are more abundant in the neutral or alkaline ones.

The importance of the application of such soil acidity data to the solution of problems in forest distribution, natural regeneration and artificial reforestation is evident. When the humus layer has been destroyed or altered by exposure to light incident to the removal of the timber, or by burning over, the chemical character of the surface soil will have most to do with determining what sort of new growth will come up, or whether efforts to reproduce the former forest cover will be likely to succeed.



Chalina oculata | Sea anemone | Corals

Animals of lower groups whose form approaches that of plants

Between Two Worlds

By Dr. E. Bade

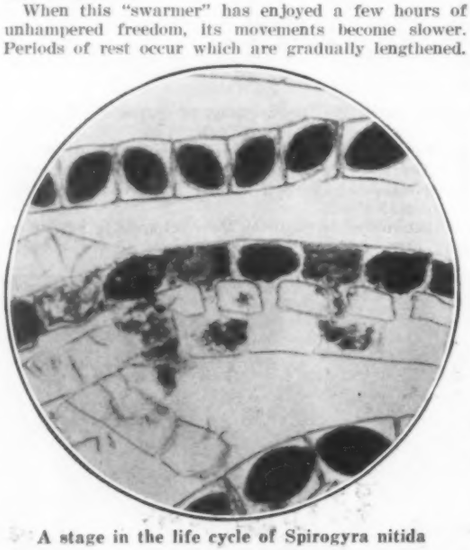
THERE is indeed a great difference between a plant and an animal. But, as we approach life's lowest ladder the simplicity of the explanation is not what it seems to be and the impossibility of distinguishing these two worlds is apparent. For one path leads us to the height of the vegetable kingdom, the other, far more tortuous and winding, leads us to the crest of the animal kingdom. But there, before the common doorway where both roads meet and go side by side for a little way, both forms are so similar, so interwoven, that it is impossible to separate one from the other.

It is comparatively easy to differentiate a tree from a mammal and to classify the former as a plant and the latter as an animal. This is obvious. The many fundamental differences in both organisms are too characteristic to be mistaken. For instance, the tree never has a mouth or an intestine, it takes its food from the outer part of its structure. But well characterized animals are known whose organization is so simple that they do not possess either of these organs. The plant's nourishment consists of inorganic substances from which organic material in produced, at the same time exhaling oxygen. But this is not a characteristic of all plants. The host of mushrooms and fungi only live from organic compounds, never do they produce them. In regard to respiration, the plants take up oxygen and give off carbon dioxide just like the animals. It is known that the process of respiration is made possible by the green coloring matter of the leaf, the chlorophyll. Only those cells in which this substance is found are able to build up organic compounds by a union of carbonic acid gas of the air and the water of the soil.

The chlorophyll bodies of some of the algae are shaped like ribbons, rings, plates, etc., but in the majority of plants they are lentil shaped, forming granular masses. The colorless protein base of this material has a delicate spongelike structure, the green coloring matter being imbedded in the web. The chlorophyll grain is the organ of activity and it aids in the production of starch. All the green parts of the plant have the inherent property of inducing this change as long as sufficient light is present, and at the same time giving off oxygen as a waste product. When the green parts of the plant are kept in the dark, the reverse is true. During the hours of the night the plant absorbs oxygen and gives off carbon dioxide. But this is also true for all those parts of the plant lacking this green coloring matter. An animal on the other hand only exhales carbon dioxide and inhales oxygen. Now a large number of plants are known which do not possess this green pigment and to this class belong all of the many parasitic plants. The respiration of these is exactly like that of an animal.

Then, too, it was believed that a difference between the plant and the animal was found in that the latter were able to move while the former were stationary. But this is not upheld by facts. For instance, the venus fly trap suddenly closes its leaf when touched by an insect. Another unique form is the sensitive plant which not only closes its leaves together when touched, but also lets them hang downward. This free movement of the plant becomes far more interesting in the lower forms of algae at the time of propagation. Seen through the microscope they consist of numerous cylindrical cells filled with chlorophyll. A lively movement of the green pigment is observable in all cells. Suddenly one of them bursts in the center and a living, animated, developing mass of protoplasm is ejected. It is a little ball. On one point a white crown is produced which soon causes tiny cillia to protrude. These begin to vibrate. The green ball rotates about its axis and rolls away in the water, animated with such life as if the plant had suddenly been transformed into an animal.

When this "swarmer" has enjoyed a few hours of unhampered freedom, its movements become slower. Periods of rest occur which are gradually lengthened.



A stage in the life cycle of Spirogyra nitida

Its sluggishness increases. In its first exuberance it approached the light, now it shuns it and seeks the darkest spots where it anchors itself to any convenient support. The cillia are withdrawn. Animal life has died and plant life begins. The head end forms a root-like structure, while the brightly colored rear end elongates after the body has been surrounded by a glassy cell wall.

A large group of animals to which the sponges, anemones, corals, etc., belong, are sometimes considered as plant animals. They have attached themselves firmly to a support, and often possess a root-like structure with which they fasten themselves to a stone or in the sand. These also have a stem, many have branches or twigs, and often apparent flowers. But they do not live like plants. They get their food like other animals, catch their prey, kill it with poisons, and digest it in a stomach. In short, although they are sessil and resemble a plant in outward form, they do not have the characteristics of one.

Just as it is with the swarming algae, so do the young remain free for a time, and it is difficult to conceive that these will later be immovable and that they must be satisfied with that which the playful currents wash their way. Their root-like structure has nothing in common with the roots of many plants. They do not assimilate any foodstuffs through it, they use it only as a hold fast. But this is also the case with a large number of plants such as the sea weeds, whose roots are only used to attach themselves to some object.

The property of reacting to a stimulus, which is generally dependent upon the existence of a nerve system, was first considered as a characteristic of the animal kingdom. But many plants react to various stimuli as has already been seen in the sensitive plant. On the other hand animals without nervous systems also respond to a stimulus.

Nowhere is a sharp dividing line to be found between these two kingdoms. No universal characteristic is applicable, which will surely differentiate between the plant and the animal world. In general it can be said that the true plants live almost exclusively upon air, water and salts, the true animals upon plants or other animals. Therefore no animals were present upon the earth before the plants existed. But living organisms are still found today which baffle the scientist. They do not seem to fit in the scheme of things.

Plants have been humorously classified as those objects which are studied by the botanist, and animals as those studied by the zoologist. At any rate the organisms claimed by both the zoologist and the botanist as their own, are so tiny, that they are only visible through a compound microscope.

Animal life is so closely bound to the plant that the extinction of one demands the death of the other. The plant is continually changing the raw material of the earth into organic compounds such as starch, sugar, albumin, fat, etc., and at the same time it recreates the oxygen necessary for animal life. On the other hand the animal not only exhales the carbon dioxide so vitally important for the welfare of the plant, but it also gives off vast products rich in nitrogen which are then available for the plant. In this way both organic kingdoms are dependent on each other.

The accompanying photographs, made by the author, illustrate some of the most striking plants and animals which are difficult to place in either the plant or animal kingdoms. The three photographs at the top of this page are of animals of the lower groups whose form approaches that of plants; so much so, in fact, that they are sometimes considered as plants by the laity.

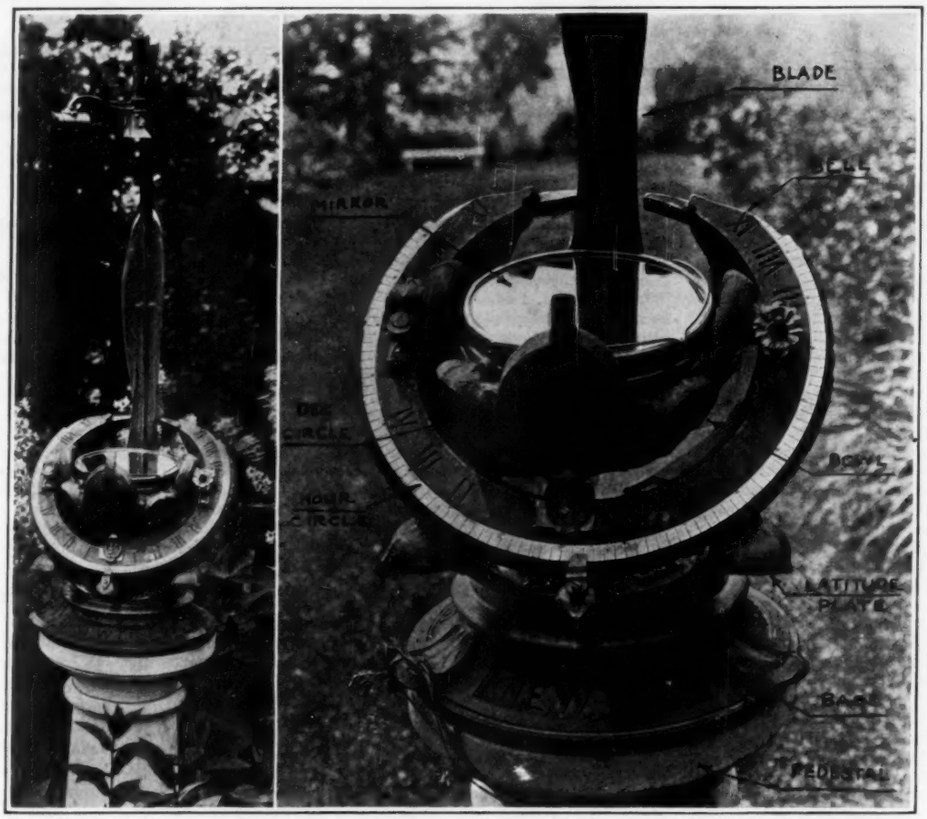
A Garden Telescope for the Amateur Astronomer

THE pleasures of telescopic observation, especially if the objects to be viewed are the heavenly bodies, are considerably offset by the necessity of continually setting up and dismantling the mounting, or support which carries the instrument. This inconvenience, together with the comparatively high cost of a powerful refracting telescope, has tended to wean away the amateur astronomer from a most fascinating field of study. The garden telescope shown on this page has been invented and designed by Russel Porter, of Springfield, Vt., and is now being manufactured to overcome these handicaps and to provide an entirely new and beautiful ornament which becomes a permanent fixture in the garden or on the lawn of its owner.

This novel instrument consists essentially of a modified Newtonian reflector, mounted so as to be able to follow the stars in their diurnal motion across the sky. The mounting is thus an equatorial one, but of unusual design. It is equally suited to terrestrial observation in the daytime, and can be used as a sun dial to obtain the time, but with a higher degree of accuracy.

As seen from the photograph, the tube of the telescope has been eliminated and the optical parts—the concave silvered glass mirror, a reflecting prism and the eye-piece, are all exposed to view. The mirror rests in a bowl of bronze lotus leaves from which rises a graceful blade or leaf carrying the prism at its farther end. The eye-piece is capable of rotation about the prism so that the observer may always look down at a convenient angle, regardless of the direction of the object. This constitutes the telescope proper. The mirror has a large light grasp of six inches aperture, which in combination with its short focus and half-inch eye-piece gives approximately 50 magnifications. The eye-piece is designed to produce an erect image.

To allow the telescope's following the stars an axis must be provided that can be adjusted parallel with the axis of the earth, and about which the telescope may revolve. To accomplish this the bowl is carried in trunnions on a second member called the bell. The bell rests on three points, one of them a thrust bearing in the polar axis, the other two being rolls on which the rim of the bell may turn. The center of weight of the telescope is thus well down in the hollow bell and well inside the three-point support, constituting a stable and rigid equatorial mounting that might be equally suitable to large astronomical reflectors.



Two views of the ornamental, tubeless, reflecting telescope, which would constitute an addition to any garden, and which is capable of real observations

For pointing purposes by day, two open sights are used on the back of the blade like the sights on a rifle barrel. For night work two graduated circles are provided. The declination circle passes around the bowl and is divided into single degrees. The hour circle is marked on the rim of the bell in Roman numerals and subdivisions of ten-minute intervals. These circles are so large as to require no verniers for setting purposes. A declination clamp is provided, and slow motion in right ascension obtained by turning either one of the rolls on which the bell's rim rests.

Finally the base supporting the bell has a horizontal circular track on which the mounting may be turned to any azimuth. This motion is found most convenient for terrestrial observation of objects near the horizon.

The range of the garden telescope is about 25 degrees of latitude and a spherical seat in the base allows an adjustment for any place in the United States and continental Europe, and, of course, a corresponding range south of the equator.

For getting the time the telescope is pointed at the sun and its image projected on a visiting card just outside the eye-piece. Apparent sun time is then read off the hour circle, and afterwards converted to mean and standard time by applying the proper correction from tables provided for this purpose.

The entire instrument is built of durable bronze and may be left out in all weather. The mirror, prism and cell are easily removed and taken indoors for safe keeping when not in use.

The brilliancy of the images, due to the high light grasp of the mirror, together with its freedom from color, render this type of telescope specially suited to day use. The design has stripped the instrument of the familiar mechanical features of a telescope and masked them in a beautiful garden ornament without sacrifice to efficiency. The silver coating of the mirror will, with ordinary care, last for years and the makers provide for resilvering at nominal cost.

The Pocket Barometer-Altimeter

THE pocket barometer, in sizes as small as 1¾ inches in diameter, some years ago was equipped with an altitude scale concentric with the pressure scale. The atmospheric pressure does not decrease in regular proportion to the altitude and therefore one scale or the other must be non-uniform. For some reason in the earlier instruments the altitude scale was made non-uniform and the pressure scale uniform. However, recently the altitude scale has been made regular or uniform and the pressure scale irregular or non-uniform. This has greatly increased the convenience of the instrument so that it is exceedingly interesting to carry one of these.

The usefulness of the barometer in forecasting weather is so well established that anyone can soon acquire skill enough to acquaint himself with approaching weather sufficiently in advance to be very useful to him. The new pocket instruments not only foretell weather but provide interesting data pertaining to altitudes. They can be obtained regularly with altitude scales for maximum altitudes from 3000 to 16,000 feet. Obviously the one whose entire scale covers from 0 to 3000 feet is more sensitive than the others. Its barometric scale extends from 28 to 31 inches. This is quite satisfactory for barometric prognostication at altitudes to about 1000 to 1500 feet above sea-level.

Such an instrument readily records altitude differences of 10 feet. For ordinary automobile touring it does not appreciably lag and therefore indicates the variations in altitude quite satisfactorily. The indicator is somewhat sluggish during the early stage of a rapid ascent in a balloon or elevator but it soon "catches up." Eventually it checks up well with larger instruments when carried in airplanes and elevators. For example, an express elevator in the Woolworth building was taken to one of the highest floors. As the elevator began its ascent the indicator did not move and for a great part of the ascent it lagged behind the true altitude. However, by the time the elevator stopped at this high floor, the reading was approximately correct. In the next ten minutes the indicator advanced only slightly. These small instruments are not sensitive enough to indicate the sudden change in air-pressure as a train enters a tunnel. They are useful in laboratories or in any experiments where pressures less than atmospheric are to be measured with fair accuracy.

The pocket barometer-altimeter having a full-scale reading of 8000 feet is perhaps the most generally useful. It is sensitive enough for most purposes and will record nearly all altitudes encountered in this country on railroads or automobile highways. The 16,000-foot instrument is sufficient for most air-travel and mountain climbing.

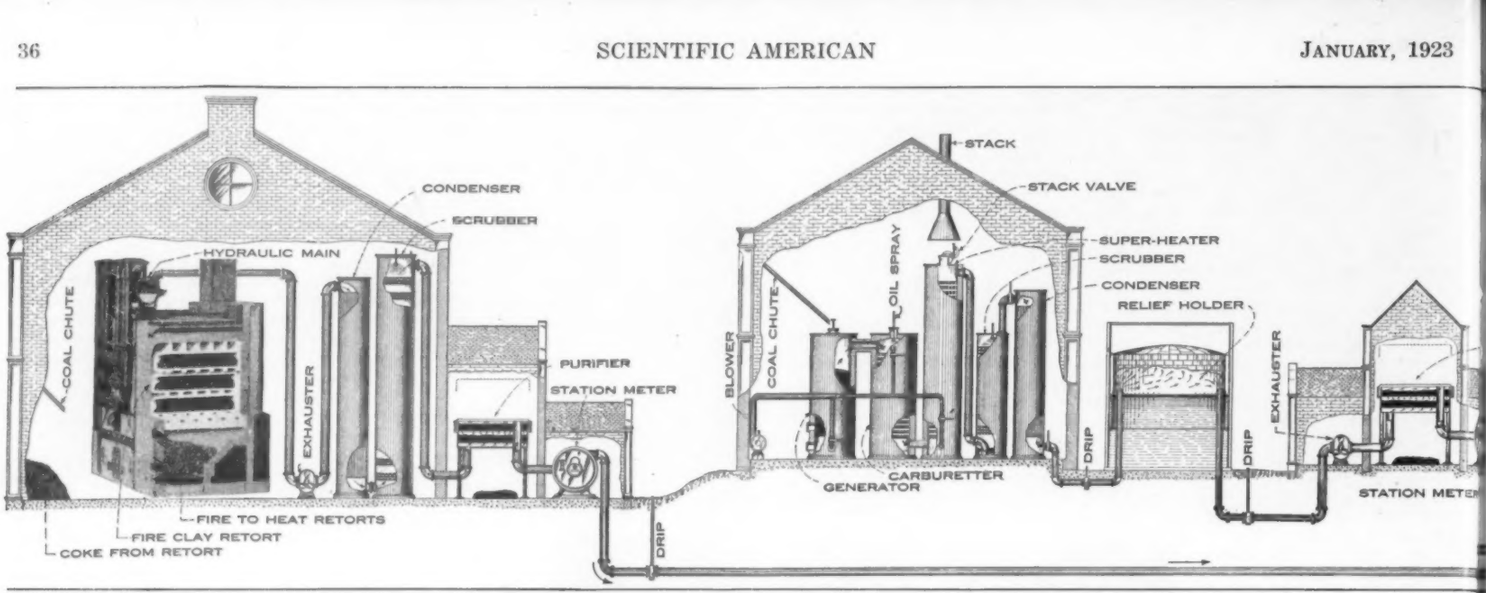
The writer has used these three sizes in many ways and finds them quite satisfactory for most purposes. Larger instruments can be obtained which record differences in altitude of one or two feet.

A Simple and Cheap Way of Getting Rid of Ants

ALL who live in the country during the hot months of the year, when insects thrive and seek to force their unwelcome attentions on the house-dwellers, especially that industrious little worker, the ant, who will penetrate into the most carefully guarded home in the search of food, will be interested to learn of a new, effective and economical method of getting rid of this pest. We quote from a letter, written to the German journal, *Kosmos*.

A swarm of black ants infested a house, situated in a garden, entering through a tightly closed door. The ants were attracted by some broken jars of jam which had been standing in that condition for quite some time before the army of ants attacked them. Various remedies were tried to destroy the pest. It was attempted to trap the ants in empty bottles, filled with a little of the jam, but without success. Then the jam was poisoned with arsenic and the jar was placed on a flat saucer. The next morning, it was observed that the swarm of ants had increased instead of decreasing. A crowd of ants was collected around the bottle of jam. The number of ants became so great that it was easy to trace the stream of the insects going to and from the sweet food under the crack of the door into the garden. The hoped-for poisonous effects of the arsenic were not fulfilled. The insects appeared to be unaffected by the poison.

It was then thought possible that the ants could be combatted effectively by the aid of a strongly smelling substance. There happened to be some tar camphor, that is, naphthalene balls handy in the house. Some of this material was ground up and a few ants were caught on the threshold of the door and encircled with a thick layer of the tar camphor. The results were quite wonderful. The insects were entrapped for about 5 to 10 minutes while they were trying to get out of the circle of tar camphor. Finally, when an opening was made for the ants to escape from the circle of tar camphor, the insects fled precipitously. Three such naphthalene barriers were erected on the wall in the garden, which was infested by the ants. No ants were able to pass the barriers and the pest was definitely overcome. It is commonly believed that ants will not cross a white line, but this fact is not sustained in practice, according to the most casual observation.



Retort and subsidiary apparatus for the manufacture of coal gas

The plant in which water-gas is made and enriched with oil

The history of man-made illuminating gas—beginning

The Story of

The Various Steps that Lie Between Raw

Compiled by the SCIENTIFIC AMERICAN *furnis*

THE GAS that burns in the modern mantles and in the cook-stoves of the modern apartment is of two quite distinct sorts—barring out, at once, the natural gas which constitutes a third sort in the regions favored by this mineral resource. Coal gas is apparently the older of the two manufactured gases. It is made by heating bituminous coal for about four hours in air-tight fire-clay retorts. The heat is not developed by burning the coal in the retort itself, as is the case in coking; the retort is externally heated, and the coal is actually distilled, as though it were not itself inflammable at all. As the gas passes off, a residue known as "gas-house coke" remains in the retort; this is drawn out and a fresh charge of coal added. The process is therefore not a continuous one in the strict sense of the term.

From the retorts the gas passes into the hydraulic main, from which it is withdrawn by the exhauster and pushed to the condenser. All these steps are clearly indicated in the left-hand unit of the drawings at the head of the page. In the condenser the gas is cooled by water surrounding tubes through which the gas passes. This condenses the tar and oil carried in the gas to a liquid which flows out at the bottom through water-sealed pipes, not shown, into the tar storage tank. From the condenser the gas goes to the scrubber, which consists of a cylindrical tower containing a number of wooden trays having slats running crosswise in checker-board fashion, and where a water spray at the top of the tower keeps the slats wet and washes the impurities down over the wet surfaces where the gas gives up its ammonia to the water. This ammonia solution is removed at the bottom through a water-sealed drain and delivered to an ammonia storage tank, not shown.

The gas next goes to the purifier, which is a large iron box containing two trays of oxide of iron, where the sulfur impurities in the gas are absorbed by the iron and removed from the gas. The top or lid of the purifier can be raised, as shown by the dotted line above it, for changing the oxide. A pile of oxide, undergoing airing, is shown on the floor underneath the purifier. The gas now goes through the station meter, which measures the volume produced; and thence to the storage holder.

The alternative gas-making process leads to what is known as water gas. If water in the form of steam is brought into intimate contact with red-hot carbon, hydrogen and carbon monoxide will be formed. This is the basic feature of the process. The steam will soon chill the carbon, which must then be reheated by shutting off the steam and blowing in air; so this process, too, is intermittent.

The details of the process are fairly simple. The fire-brick-lined generator has a thick bed of coke or coal, which is burned by forcing air up through it. If enough air could pass up through the fuel bed to burn the coal completely into carbon dioxide, the process would have to be differently regulated; but this is not possible, so the gas given off at the top of the generator will be the inflammable monoxide and hydrogen.

No fault can be found with the inflammability of this mixture, but it does not burn in a manner making it an ideal domestic or commercial fuel. Its heating value is not as high as economical use demands; and formerly a more serious objection lay in its deficiency in luminous qualities. Nowadays, however, the luminous mantle has so largely replaced the open jet that candle-power requirements are out of date; gas that burns with a wholly invisible flame is just as good, for heating a mantle to incandescence, as the most brilliant naked jet. Laws prescribing the candle-power of domestic gas are therefore of value only in proportion to the obstinacy with which the users cling to antiquated equipment, and the gas companies are working, with some success, for their elimination from the statute books.

In any event, however, greater heating power in all cases and greater lighting power in some cases are required than would be given by the pure water gas from the generator. This gas is therefore "enriched" by combining it with oil under such conditions that the oil is gasified and held in suspension in the gas. The process is known as carburetting and the apparatus in which it is carried out as the carburetter.

The carburetter and super-heater are brick lined shells containing brick laid crosswise, checker-board fashion, so as to leave open spaces between the bricks. By admitting air at the top of the carburetter and at the bottom of the super-heater, the gas coming from the generator can be burned. The burning of this gas heats the brick checker work and the burned gases finally pass out at the open valve at the top of the super-heater through the stack into the atmosphere.

When the fuel bed in the generator becomes hot enough, the air valves and stack valve at the top of the super-heater are closed and steam, through a connection not shown, is turned into the generator and, passing up through the highly heated fuel, forms carbon monoxide and hydrogen. These gases burn with a pale blue non-luminous flame and are known as "blue water gas." Oil under pressure is sprayed down over the hot brick-work in the carburetter. The hot brick here and in the super-heater converts the oil into a fixed gas, as indicated above. The gas entering the bottom of the scrubber must bubble through a water seal, which prevents a return flow. In many plants this bubbling and sealing goes on in a separate box called a washer.

The scrubber consists of a cylindrical tower containing a number of wooden trays having slats running crosswise in checker-board fashion and where a water spray at the top of the tower keeps the slats wet and the gas is washed clean from its tar and carbon particles.

In the condenser the gas is cooled by water surrounding tubes through which the gas passes. This condenses the tar vapor carried in the gas to a liquid which flows out at the bottom through a water-sealed pipe, not shown, into the tar storage tank.

From the condenser the gas goes to the relief holder, which equalizes the delivery beyond on account of the intermittent operation of the process. One complete cycle of getting the fuel bed ready and making a "run of gas," takes about seven minutes. The relief holder is merely an open top circular tank filled with water in which a smaller open bottom tank is placed so that the gas can fill the space between the water and the top of the smaller inside tank called a "loft." When the gas volume is increased the lift rises; when decreased, it descends. The weight of the lift produces pressure on the gas.

A shaving scrubber, that is, a steel tower filled with wood shavings, is frequently placed between the relief holder and the purifier in order to catch and remove droplets of tar that may be still remaining in the gas.

The gas is pulled out of the relief holder by the exhauster and goes to the purifier, which is a large iron tank containing two trays of oxide of iron where products sulfur impurities in the gas are absorbed by the the term and removed from the gas. The top or lid of the purifier ga can be raised, as shown by the dotted line above, this na changing the oxide. A pile of oxide, undergoing air manufactu shown on the floor underneath the purifier. The gas made goes to the station meter for a production meteri ral wel is piped thence into the storage holder. In open

In some plants coal gas only is produced, in ential—a water gas only, and in others both are made and use—the At the present, about 60 per cent of the gas sold used. public utility service in the United States is carbu as is ma water gas. The percentage of acetylene and oil gas rate of small. Due to changing fuel conditions, the olors of the

PERHAPS no invention of first-grade imp received much abuse as did illuminating gas. The the pho portant developments, found the public in attitud early models and to anticipate the day when de ould ha of satisfaction. It is a common thing today to d in thi device is not perfected, it undoubtedly will ult carried t vice. But at the time when it would have been i end suc industry, gas was denounced by Napoleon as a d by Si

Gas has made its place; but even today it place a ought to hold a more enlightened attitude. We pt to lo ondary importance. A little attention to the fac that th

Gas is served to 4600 municipalities by 9 es.

There are 9,200,000 gas meters, serving, many bas persons—about 40 per cent of our population.

With 69,500 miles of gas mains, there are s per m

The annual production and consumption ed gas at $380,000,000.

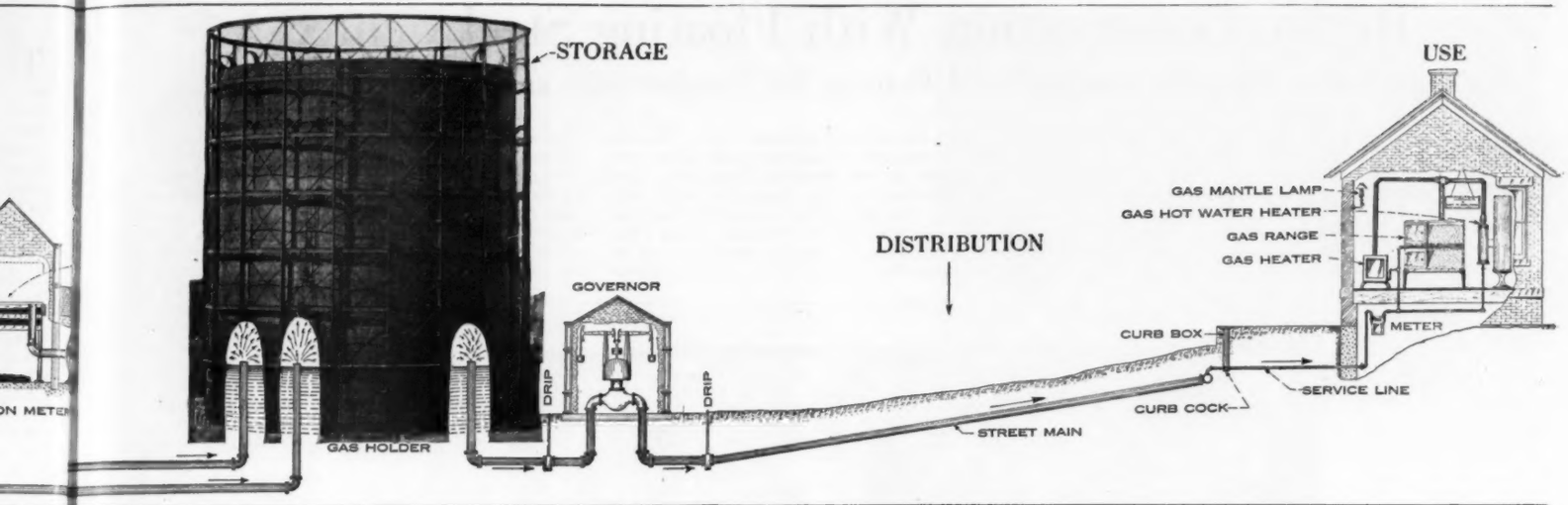
Of this total, 18 per cent is used in illumi per cent tion, 22 per cent for industrial and 3 per cen laneous 1200 different industries.

Each year there are used in the manufacture 0,000 anthracite coal; 2,400,000 tons of coke; 900,00 ns of ga

In 1921 there were in use 7,000,000 as cook 1,250,000 gas space-heaters; 8,800,000 incan ers, not

The annual consumption of gas per meter ubic fe has increased from 1310 cubic feet in 1901 to feet in

candle-power standard should be abandoned and the input a ing-value standard lowered so as to permit a more e princi nomical utilization of cheaper raw fuels. The be capacity coke ovens in the United States waste annually 1 over 150,000,000,000 cubic feet of gas, which is equal to n the inc one-half of all the manufactured gas sold in the U several States. In the presence of a lower heating-value stan e of ga this could be largely saved by a wider substituti s the ga



The storage tank to which gas of either or both varieties is delivered

The apparatus of distribution to the ultimate consumer

minating eginning to end, told diagrammatically

e S of Gas

etwe Raw Coal and the Domestic Burner

RICAN *furnished by the Smithsonian Institution*

n whe oducts ovens for the highly wasteful beehive type. by the e term "artificial" has frequently been used for manu- f the ired gas; but as the gas is manufactured from crude e abov this name is in a sense not indicative, and the term ing air nufactured" gas would be better. That is, the gas is The gas made in distinction to the nature-made gas of the neteri ral well. Because of the early use of manufactured in open flame burners where luminous properties were d, in ential—although the mantle lamp now makes this ob- e and —the term "illuminating gas" has frequently also s sold used.

carburas is made at practically a uniform rate for 24 hours. d oil g rate of use of the gas varies largely during different the ours of the day. The function of the holder is to equalize

de imp received, during its period of incubation, quite as . The the phonograph, the radio, scores of other im- blic in attitude, ready to excuse the shortcomings of hen de ould have led to a machine giving a high degree day to d in this fashion and to say that while a given vill ultimately ried to perfection and will then give great ser- been ind such encouragement to the pioneers of the gas n as a ed by Sir Walter Scott as a pestilential innovation. oday in place against the grudging consent of those who We pt to look upon it as a makeshift, a fuel of sec- the fact that this is not just. In the United States:

s by 9 es.

rving, mary basis of five persons per family, 46,000,000 tion.

here are s per mile.

ption ured gas is 330,000,000,000 cubic feet, valued

illumi er cent for domestic purposes other than illumina- er cen laneous purposes. The industrial users represent

facture 0,000 tons of bituminous and 1,800,000 tons of 00,00 s of gas oil.

0,000 as cook-stoves; 1,500,000 gas water-heaters; incan ers, not including street-lighting installations.

meter ubic feet. The annual consumption per capita 01 to feet in 1921.

d the input and output. The storage holder works on the more principle as the relief holder; however, to increase he ca capacity, several telescopic "sections" or "lifts" are ally all over one tank of water and these rise or go down l to ne the increase or decrease in gas volume in the holder. the several lifts have water sealed connections to prevent e stamp of gas at the telescoping joints.

titution the gas comes into the holder and raises the telescoping sections, the weight of the metal that the gas must support increases and this increases the pressure on the gas, therefore, the higher the holder is raised the greater must be the resulting gas pressure. To furnish a more uniform pressure to the consumer, the gas now goes through a governor which is merely a mechanical device where a variable intake pressure is changed to a practically uniform pressure in the mains.

From the governor the gas goes into the street mains, through the curb cock, service line, house meter and to the consumer's appliances. Manufactured gas contains condensable constituents that collect in low places in the mains; therefore, drips are necessary and must be pumped out at intervals. In some plants, Chicago, for instance, when the gas comes out of the storage holder, it is compressed and carried through medium-pressure lines to various districts and the pressure then reduced. This is more economical in certain plants than to carry all the gas the entire distance at low pressure.

Gas service is radically different from every other kind of public utility service in that the gas cannot be used by the consumer as received, but—first, must be mixed in proper proportion with atmospheric air by the consumer at the burner; second, this mixture must then be completely burned; third, the flame must be so directed that the heat generated will effectively get into the food, air, water, or mantle that is being heated, with a minimum loss. The results obtained will depend primarily on the gas utilization appliance and the consumers' skill and care in operating. All these operating features are beyond the gas company's control, but are vital in determining the quality of the service produced by one consumer and the effect on the service of other consumers. A thorough understanding of the appliance situation in the home, is, therefore, of vital interest to the gas user.

A Practical Contact Attachment

AT the last automobile show in Paris a small device was shown for the ready establishment of an electric contact without either bolt or screw. The specimen exhibited applied more particularly to the ignition devices of explosion motors; but the device can also be utilized upon all contact posts for obtaining electric connections. "Everyone knows," says a writer in *La Science et La Vie*, "how disagreeable it is to have to unscrew the bolts upon ignition devices when one wishes to interrupt the current. The bolt is always oily and it is so small that it is hard to catch hold of it without burning one's fingers, while if the motor is going one is apt to receive shocks."

In order to avoid these different inconveniences the present attachment comprises a steel head in which a small piston moves which is constantly brought forward by a spring opposite it. This piece of steel is screwed upon an ebonite tube into which passes the electric wire whose end is attached to the movable piston. The steel head is pierced by a hole into which passes the current post of the ignition device. This post has a spherical form. The piston is hollowed at the end in such a manner as to fit the post exactly and hold it in position.

By pulling the wire the piston is brought to the interior of the ebonite cylinder; the steel cage is thus liberated and the contact post is placed in it; when the wire is then let go, the piston is pushed forward by the spring and the post is held tight. When it is desired to set the post free the operation can be reversed with the same readiness. The operation can be performed with one hand when, for example, the motor has only three cylinders running, and one desires to know which ignition spark does not ignite, by isolating them in turn.

The device can also be used in automobiles lit by electricity to establish movable and rapidly detachable contacts by the side of each headlight lamp or lantern. All that is necessary is to have a contact post of spherical form in order to make use of this attachment.

New Neon Lamps

THE idea of using an electric discharge through a rarefied gas to produce light is familiar and is exemplified in the tubes containing neon gas which have been used in advertising signs for some years. Such signs, with letters or other devices outlined in glass tubing filled with luminous neon gas, were much used in Paris in the years succeeding the armistice, owing to their relatively low consumption. During this period the electric supply companies in Paris had great difficulty in meeting demands for electricity and accordingly any lavish consumption for this purpose was forbidden. These long tubes, filled with gas emitting orange red light, produce a striking effect, but they require a pressure of several thousand volts, and are expensive to install.

Quite recently, however, a new form of neon lamp ("Osglim"), capable of being used on either direct or alternating circuits of 200 to 250 volts has been described before the Illuminating Engineering Society in London. The lamps are made up to resemble an ordinary incandescent lamp in general appearance, and can be inserted into the usual forms of lampholders. The bulb is filled with neon gas at low pressure and the electrodes, are brought very near together. When the lamp is switched on the electrodes, usually arranged in the form of a star, become coated with a layer of luminous gas. On alternating circuits the light is evenly distributed between the two electrodes, but on direct current it is emitted from one electrode only. This fact has been ingeniously applied to produce a novel form of luminous sign, the electrodes being given the forms of letters of the alphabet or numbers, so that any desired inscription can be indicated by a row of lamps.

Although the light emitted is at present small these lamps have the advantage of very low consumption, namely, only 5 watts as compared with 20 watts furnished by the smallest incandescent lamp for 200 to 250 volts. The peculiar orange color of the light readily attracts attention. The lamps are also suitable for night lights, pilot lamps, etc., and in circumstances where little light is needed and small consumption of current is essential. As the light is confined to the red and orange part of the spectrum they also serve as a safe and economical source for a dark room, if equipped with a ruby glass bulb.

One other unique property of the lamps may be mentioned. With incandescent lamps a "flashing" effect must be produced by some form of electromagnetic or thermal interrupter, which opens and closes the circuit at regular intervals. Such devices have a limited range, and are liable to get out of order. But if a neon lamp is shunted with a condenser and with a resistance in series with the combination, regular blinking on alternating circuits, without any moving mechanism, is automatically produced. By adjusting the condenser and resistance the frequency of blinks may be altered from one every ten minutes to 15,000 per second.

Bridge Construction With Floating Steel Centers

Substitution of Movable Hinged Steel Centers for Cumbersome and Costly Wood Centers

AN IMPORTANT work of bridge reconstruction is now being carried through in rebuilding the Harrisburg bridge of the Philadelphia & Reading Railroad across the Susquehanna. This work is particularly interesting because of the way in which the problem of arch centering is being handled. The new bridge, which is being built of concrete, consists of 46 arch spans; but since it is a two-track bridge and is being built in two halves, that is to say, one stretch of 46 spans is being built at a time, it follows that the centering has to be set up and taken down some 92 times in all. Under former methods, when the centering was usually built of timber, it would have been necessary to dismantle each center piecemeal, and re-erect it for the next arch. This would have meant a vast amount of labor in these times when labor costs are so high, and, moreover, the centering would be subject to rough usage and could only be used satisfactorily for a certain number of spans. The problem of working out a more expeditious and economical method was handed over to the Blaw-Knox concern, of Pittsburgh, Pa., which designed and built the novel and ingenious plant which forms the subject of the accompanying illustrations.

From steel to concrete. Reconstruction of railroad bridge across the Susquehanna at Harrisburg. Ninety-two arches are being built on the movable, floating centers shown below

Now, since only one-half of the bridge was built at a time, it was necessary to erect and remove the centering for each arch twice, and in addition to the difficulties of using timbering centering mentioned above there was the question of driftwood, ice formation, and the freedom of navigation to be considered. So it was decided to build a portable steel center, or rather a series of them, each of which could be moved intact to a new arch and erected ready for the concreting. The plan which was adopted was as follows:

A steel center was built, consisting of three ribs with a hinge at the crown. The ribs were parallel to each other, strongly braced together, and lagged so as to form a seating for the concrete. Since the height of the spans above water varies, it was necessary to provide means for a vertical adjustment of the center. This was done by using a large scow, upon which was built up a rectangular steel erecting tower. Around this was built a movable rectangular frame, which was arranged to slide up and down the fixed tower and around this another movable frame provided with cantilever arms. This last frame is capable of vertical movement up and down the intermediate frame. The arches, which are circular, have a clean span of 66 feet, and the projecting cantilever arms reach to within three feet of the piers on each side. The raising and lowering of the two movable frames is done by means of four hand-operated winches, *A A*, *B B*, operated through a worm drive, an arrangement which gave accurate control at all times of the movements. Our line drawing shows the position of the centers on the ends of the cantilever arms, which, while they are being carried on the scow and moored in position, are drawn in, as shown on the right-hand side of the drawing. As soon as the center has been raised to the proper height, its ends are moved outwardly until they are in the correct position above brackets *C*, *C*, recessed in the inner face of the pier. On the right-hand side of drawing the base of the center is shown in the drawn-in position and resting upon a trolley whose movements are controlled by a worm gear. On the left-hand side, the bottom of the center has been moved outwardly into position, and is shown resting upon the bracket.

It should be made clear at this point that since the number of concrete arches is double the number of old steel trusses which they replace, it was necessary to build an additional pier between the existing steel piers and to build around the old steel piers a concrete tower symmetrical with the others. One of our illustrations shows five of the steel centers in position with the concrete arches in course of construction on the two at the shore end of the bridge.

When the concrete has set, all that is necessary is to draw in the ends of the center until the whole is clear of the arch. At the same time the two movable frames are lowered on the tower, this with a view to a lowering of the weight and ensuring the stability of the scow while it is being towed to the next opening. When the scow has been moored exactly in position, the frames are raised, the cantilever ends are forced out into position, and the whole center is lowered upon the pier brackets.

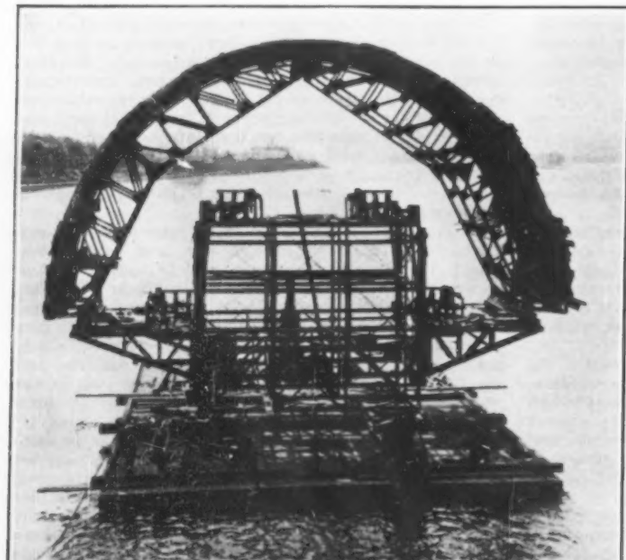
It takes about a day to change a center from arch to arch, and this includes all the adjustments and raising the center to position ready for the concrete. It takes about 2½ hours to lift the center from its lowered to its working position.

It will be understood, of course, that during the construction of the bridge only one of the two tracks is available for traffic. At present the trains run over the steel trusses that are still in position. As soon as one line of arches is completed, the tracks will be shifted and the construction of the second half of the bridge will be commenced.

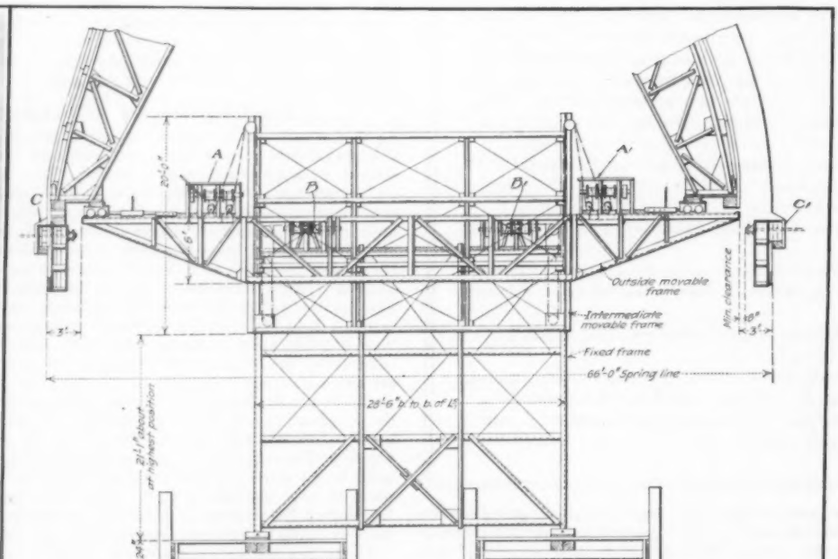
Radio Telephony Range Tests

VALUABLE assistance has been rendered the Bureau of Standards by amateurs throughout the country in the range tests which the Bureau is conducting. Nearly a thousand reports have been received from two of the sending stations, and a preliminary analysis of 500 reports from the first station have been made, the work being greatly expedited by a sorting and counting machine already described in these columns, loaned by the Bureau of Census.

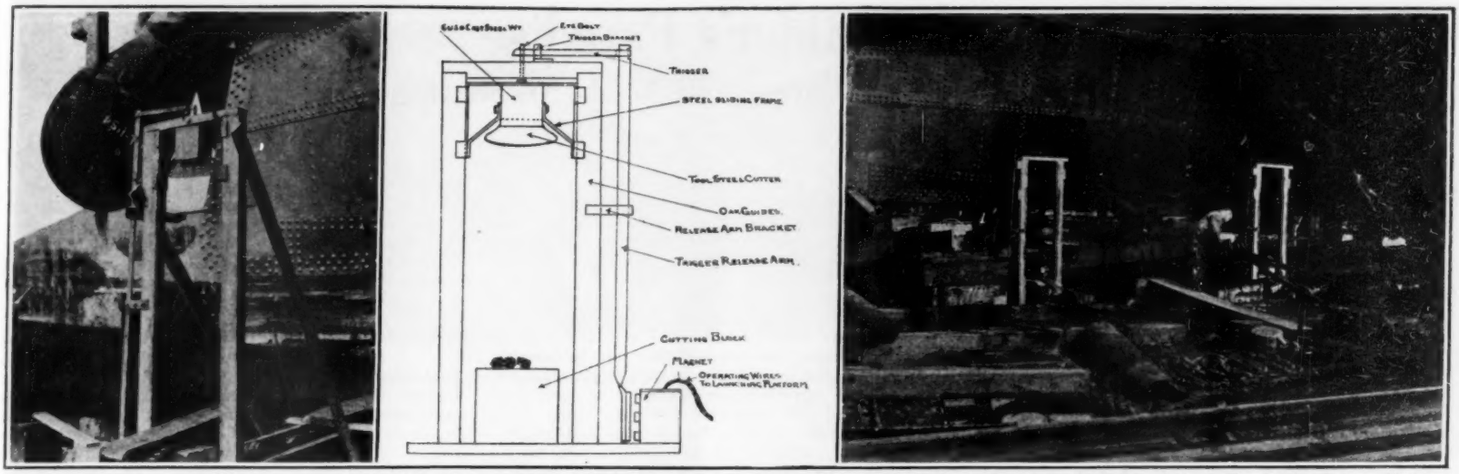
A report describing this study and entitled "A Preliminary Statistical Study of the Range of Radio Transmitting Stations" has been prepared. It is interesting to note that brief attention has been given to the application of the theory of probability in relation to the results of this transmission test. The test will be continued with the assistance of the Department of Agriculture, a member of the staff of that department carrying on his work for the Bureau at Minneapolis.



One of the steel centers being floated to position. The center is lowered during transit to insure stability



This shows the barge, the supporting tower, the vertically movable frame with its cantilever arms, on which rests the steel center



Left: Close-up of one of the holding ropes, showing the guillotine and the wooden bar over the rope to protect it against accidental descent of the knife. *Center:* The details of the guillotine. *Right:* More general view of the launching party

Novel way of severing the ropes at the critical moment in the sideways launching of ships

Sideways Launching Made Safer and Surer

THE accompanying photograph shows a new device used in cutting the ropes in launching a ship sideways. It is called a guillotine and is electrically operated. Two of these guillotines are placed at each end of the boat when ready to launch, and by pressing a button all four of the guillotines are operated simultaneously, dropping a sharp knife which cuts the rope, permitting the vessel to start down the ways on a perfectly even keel.

The practice in side launching has been to hold the ship by triggers held by ropes at each end of the ship. These ropes when everything is ready are cut with axes at a given signal by four men. If all of the ropes are not cut at exactly the same instant the ship will not slide down on an even keel. The use of the axe is also dangerous, in that the suddenly released cut end of the taut rope is likely to give a vicious snap in any or all directions. The guillotine does the work automatically without risk of injury to anyone.

Centrifugal Car-wheels with Manganese-Steel Rims

THE demand of the railroads for a heavy or stronger wheel to put under the great steel cars, which are constantly growing larger and heavier, has been met in some cases by a steel wheel. There are various kinds of these, some of them forged from steel disks and some cast. They are being used to supplement or displace the regular chilled iron car wheel and are being used largely on the large steel passenger and similar cars.

Of the steel wheels on the market, probably the most novel and interesting is the one known as the Davis wheel, which is a cast steel wheel of special composition. The novel feature is that it is cast in a rapidly revolving mold, the illustration explaining this fairly clearly. The hot steel from the ladle flows into the car wheel mold, situated on a revolving table. This motion of the mold throws the liquid steel to the outer part of the inside of the mold, where it chills first, forming the rim or tread of the wheel. The important feature, however, is that powdered manganese in the form of ferro-manganese is injected or blown into the liquid steel, in the early states of the pouring. The presence of the manganese in the steel makes the steel rim of the wheel much harder, forming manganese steel at that point. The jet of powdered manganese is driven under air pressure right into the stream of hot steel.

As the rim of the mold of the wheel fills up, the jet of manganese is gradually reduced so that manganese steel is no longer produced as the mold fills up with steel, the result being that the central part of the final wheel, when the mold is full, is plain carbon or simple steel and softer than the outside of the wheel.

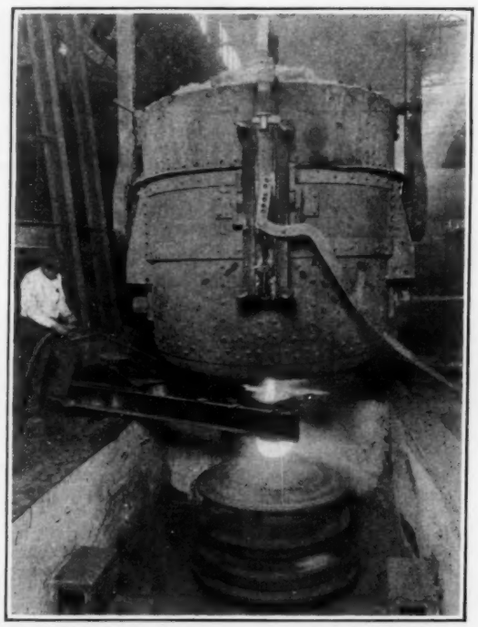
Wheels of this kind are being made on a large scale in this country and are finding successful application on many American railroads.

The Chemistry of Life and Orthogenesis

IN a paper read before a symposium on orthogenesis before the American Society of Zoologists recently held at Toronto, Professor L. T. Henderson, of Harvard University, says: Because of its peculiarities as a solvent, as an ionizing medium, etc., water makes possible the formation of an almost indefinitely greater variety of physico-chemical systems than does any other substance. On account of its high latent heat of vaporization, its high specific heat, its high surface tension, and the peculiarities of carbonic acid, such systems often possess a very remarkable stability. The elements hydrogen, carbon and oxygen, of which water and carbon dioxide are composed, seem to be unique in form. In particular, the production of sugar from water and carbon dioxide fixes a very great amount of energy and leads directly to the greatest variety of chemical substances and reactions that are known to occur as the result of one chemical process. Finally, water and carbon dioxide are the two substances which are everywhere available.

Anything so complex, so stable and yet so variable, so widespread and so active as life can only occur when a great variety of conditions are fulfilled. In other words, the physico-chemical systems of the organism, in order that life shall be capable of its evolution, must possess altogether exceptional characteristics, which appear to be quite impossible unless water and carbonic acid, and compounds of the three elements, hydrogen, carbon and oxygen, and no doubt also of nitrogen, are at the basis of them. So far as we know, no other elements or compounds possess another set of properties which permit similar physico-chemical complexity or variability.

Thus while the evolutionary process has certainly produced a large number of well-defined series of changes when it is looked at from the morphological point of view, it still remains very probable that such physico-chemical changes as have occurred are not only of a secondary nature, but that they are much less of the character of serial modifications. It seems to be almost self-evident that progressive morphological evolution should not be accompanied by the same degree of continuous variation in straight lines in physico-chemical properties. Accordingly, any theory which postulates continuity in evolution is very unsatisfactory to the chemist.



As the jet of molten steel passes from the ladle to the rotating wheel-mold, a jet of manganese is forced into it, giving a super-hard rim on the finished wheel

The Bread Beetle: A Living Yeast Producer

THE following extract is taken from an article on the "Adaptation Between Animals and Fungi." The article appeared in the German journal, *Bund zur Foerderung der Pilzkunde*, July 27, 1922. The article contains a number of very interesting and odd observations, made on various insects and their habits, the most important of which are given below.

It was found that it is just the higher toadstools, which afford a most impressive example of such adaptation, inasmuch as snails, flies of all sorts, beetles and the like have chosen these plants both as food and as a domicile. Arrangements were made to investigate the individual kinds of toadstools and mushrooms, particularly the poisonous varieties as well, to see whether they expressly harbor adapted flies or their larvæ. Insects are, to be sure, quite often insensitive to poisons, particularly the poisons which affect the nervous system. Whether these inhabitants of toadstools are of any importance for the distribution or fertilization of the spores of these plants has been investigated to a slight degree up to the present time. If not, then there is no reciprocal advantage gained by the plant.

However, there are many insects, which breed or grow yeast, mold fungi and bacteria in their very bodies and in which special organs are set aside just for this purpose. The author calls particular attention to the remarkable symbiosis between the bread beetle and a form of yeast, which it produces in a large number of sacs, arranged in the form of a rosette around the middle intestine. The production of the yeast takes place in such a degree that the animal may certainly be called a yeast factory of the smallest caliber. The sacs and likewise two long tubular organs, arranged along the lower limbs of the animal are filled full of masses of yeast. The bread beetle, which is about two millimeters long, must produce, it is estimated, about 10,000,000 yeast cells at the very minimum. Each egg that the beetle emits from its body has a coating of yeast on its shell, which the young larva, eating through its shell, swallows up in time, whereas the larvæ themselves become similarly infected with the yeast cells. There is still no certain theory concerning the significance of the yeast cells within the body of the beetle, which will live in the driest kind of bread and pieces of zwieback whose main article of food is starch grains. When the bakers of bread prefer to use yeast in place of baking powder in baking bread—yeast is very rich in vitamins, baking powder does not contain even a trace of these substances—then they can refer to the bread beetle, who provides for this as well in his intestine, so that the starchy food is also digested by means of yeast so as to gain the available vitamins in the latter.

A Builder's Paradise

Ground that Cuts Like Cheese and Needs No Shoring or Piling

By Leonard Matters

THE PERUSAL of an article in the June number of the SCIENTIFIC AMERICAN on the bearing strain of the hard-pan on the site of the Union terminal at Chicago, directed the attention of the writer to the vastly different conditions, from the builder's point of view, which exist in Buenos Aires.

For months past the writer has had every opportunity to note the facility with which deep excavations can be made in the Capital City of Argentina, and the simplicity of the work of laying foundations, because in his office on the fourth floor of the American Express building, he looks down a hundred feet into a pit that some day will be the basement of the local edifice of the First National Bank of Boston. There was a time, only a few weeks ago, when it seemed little more than a push was necessary to send the Express building into the pit, and one not acquainted with the remarkable holding condition of the ground on which Buenos Aires is built would certainly have been nervous when occupying a room perched apparently so perilously over where men were quite casually breaking down the soil, flush with the wall. Practically no props were sustaining the wall, and underpinning was not thought of because it was quite unnecessary. The engineers engaged on the Boston Bank building simply cut away the hard-packed earth for 33 feet below the street level, and the Express building stood on its own foundations 20 or more feet above the lowest depth of the adjoining excavation—the four-story wall and the fresh brown earth below it forming a perfect perpendicular.

The ground beneath Buenos Aires is of such character that a sheer cut can be made down from the bottom of the foundations of an adjoining building, without any necessity for shoring. This is not in rock, but in hard-packed soil that yields to the hand-shovel

It is doubtful whether similar ideal conditions for excavations exist in any large city in the world, and the wonderful holding capacity of the ground is all the more remarkable from the fact that it is not clay that is being worked in. As a matter of fact clay is one of the rarest things to be found in Argentina—hence the foreign builder's complaint that the bricks are so poor. Buenos Aires for the most part is built on what was originally the bank of the River Plate, and the site of the Boston Bank is roughly 50 to 60 feet above river level. The soil is a very hard-packed pug that goes down to the "tosca" or hard-pan. "Tosca" is a hard shale, but it is not evenly distributed, occurring in something like boulder formation below the pug, and here and there permitting the intrusion of silt and water where the river level is approached. So long as building is being done on a site like that chosen for the Boston Bank excavations for foundations present no difficulties, but when construction is called for below the "barranca" (bank) then much the same problem that exists in other cities has to be faced. The "tosca" is then quickly reached, and silt and water are met with, concrete caissons having to be laid for foundations and shoring, sheet-piling and underpinning being necessary, the latter where there are adjoining buildings.

In excavating for the basement and foundations of the Boston Bank the contractors had to remove about 25,000 cubic yards of earth and the process was simplicity itself, with practically no concern for the buildings abutting on the site. The well-packed soil of Buenos Aires cuts like a solid cheese, and can be sheered off flush with an adjoining wall. In general the system employed to break it down is to cut two vertical channels down the face of it to a depth of five feet; undercut a lateral channel, say ten feet down the face, and then use bars to wedge off blocks of about ten tons. The "chunk" off the cheese is then broken up, shovelled into buckets and hauled to the surface. The face will stand firm even where one might suppose it would crumble under vibration from heavy traffic on the street above. Shoring or piling is rarely necessary.

Excavation on the Boston Bank site was started in June, 1921, and finished in May of this year, the area excavated being roughly 19,000 feet to a depth of 33 feet. If the expert comment on this fact be that the job was slow, the explanation is that work could not proceed at a normal pace because the municipal authorities had not finally approved the plans. Incidentally it may be remarked that if some building conditions in Buenos Aires are ideal others are the reverse, and among these are the restrictions imposed by the city council. It takes a long while to get plans passed upon, there being, besides the engineers and architects of the municipality, another body of esthetic gentlemen who must be sure that a design conforms to their conception of what is art. Three years will be required to complete the Boston Bank, when the same work would be carried out, free from extraneous delays, in the United States in a little over a year.

Returning to the point, the excavation referred to took place with heavy street traffic going on on three sides. Only at the street level where old rubbish filling was encountered, was any piling done, and during the excavation the only fall of earth, not deliberately promoted, was about a ton of rubbish that got away unexpectedly during a storm.

As possibly building engineers will be interested in some details of the Boston Bank structure the writer mentions the following facts: The site is roughly triangular, with frontages to Avenida Rogue Saenz Peña, Calle Florida and Calle Bartolome Mitre. This land is part of the property compulsorily purchased by the city to admit the cutting of the new diagonal boulevards through Buenos Aires, and the site is one of the most valuable in the heart of the city. The building will have nine stories above, and two below street level, the height being restricted by municipal ordinance which prohibits a structure higher than 36 meters (about 120 feet) along the new boulevards. This restriction applying to such a valuable site necessarily reduces the interest earning capacity of the property, the number of offices for rent being limited.

The building will have a steel frame, the weight of material being about 1600 tons, all of which is being made and erected by a New York concern. Though it is calculated that the bearing strain of the soil is equal to six or seven tons per foot, the limited height of the building will only impose 3½ tons per square foot pressure on footings. The latter are of reinforced concrete to a depth of six feet below ground, and the heaviest load on any footing will be 500 tons. The new bank will cost approximately $1,700,000 U. S.

Removing Spots From Leather by Means of Rubber

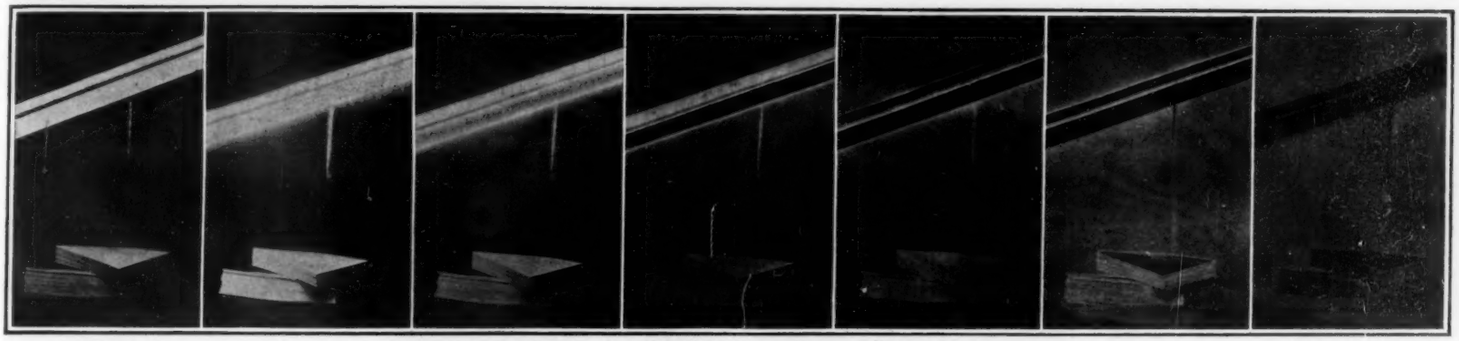
LEATHER articles are very apt to get spotted in various ways. Shoes, handbags, traveling bags and other common leather articles, that are used every day, may come in contact with such materials, as grease, oil, butter, lard, vaseline, linseed oil, salad oil, lubricating oil and other materials of the same nature, and when they do, the result is an ugly spot on the leather. Such spotted leather is very unsightly, and the value of the article is considerably reduced thereby. It is therefore natural to try to remove these spots in the ordinary way by rubbing the leather with a cloth dipped in a fat solvent, such as benzine, gasoline, etc. But, though this method is very effective when the spots are on clothes and textile fabrics, it is absolutely unsatisfactory when applied to leather. Instead of the spot being removed, the treatment causes it to spread over the surface.

A method has been developed by the Bureau of Chemistry of the United States Department of Agriculture for cleansing stained leather, which gives very good results and is very easy to carry out. It consists in coating the spots with a thick solution of rubber in a solvent that evaporates readily, and then in removing the film of rubber when it is almost dry. The spot will come off with the rubber film. While in most cases just one treatment will suffice, in certain others it is necessary to repeat the operation several times.

The rubber cement can be made with Para or Ceylon unvulcanized rubber in the proportion of one part of the rubber to ten parts of the solvent, carbon disulfide, by weight. Certain prepared rubber cements may also be used for this purpose to good advantage. It is important that the cement be very thick and quick drying and that a pure solvent be used. There is a disadvantage in working with carbon disulfide, due to the fact that its vapors are poisonous and very inflammable. When a carbon disulfide cement is used, it is necessary to work away from flames and where there is good ventilation. To keep the rubber from adhering too tightly to the leather, the leather in the immediate neighborhood of the spot may be wetted slightly just before applying the rubber solution. Too much water, of course, must not be used since this would prevent the desired adhesion of the spot to the rubber.

Milk will produce spots on leather, due to the fact that milk contains butter fat. In addition to the grease stain, it sometimes leaves a white residue and sometimes a dark stain. The white residue may be removed with soap and water, but there is no known method of taking out the brown stain. The only way in which leather, which has been stained in this manner, can be improved is to dye it darker than the original color, and darker than the spot—the new color in this way swallowing up the spot.

Any oil or grease spot should be removed as soon as possible. It is especially important that spots caused by linseed oil and other paint oils be removed before the oil dries, since the oxidized oils are only slightly soluble in the liquids ordinarily used.



A—1/5 second *B*—5 seconds *C*—20 seconds *D*—1 minute *E*—5 minutes *F*—15 minutes *G*—2 hours

Eight exposures made by the light of the mercury-vapor lamp shown in the prints, given various times as indicated, and developed in the usual way under the red light of the dark room

Tricks of Over-Exposure

By L. Pyle

Professor of Physics, Washington University

FEW amateur photographers are aware that over-exposure of a plate or film yields a positive upon development, instead of a negative, provided the over-exposure is sufficiently pronounced. On the other hand, few professional photographers are aware that over-exposed plates or films may be *developed in the light*, very often yielding better negatives than when developed in the dark-room.

The differences between the two series of accompanying photographs arise solely from variations in the time of exposure and from the fact that one series was developed in the dark-room while the other series was developed in the light. A stack of white envelopes was placed below a mercury-vapor lamp, with black cloth as background, and photographs were taken by the light of the lamp itself. Film was used in the camera and photographs *A*, *B*, *C*, *D*, *E*, *F*, and *G*, were obtained by making exposures respectively of ⅕ second, 5 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes and 2 hours. This series was developed in the dark-room in the usual manner under red light.

Photographs *a*, *b*, *c*, *d*, *e*, *f*, and *g* were obtained by exposing precisely as in the first series—⅕ second, etc., respectively, the only difference being that the series was developed *in the light* at a point midway between two 16-candlepower lamps placed ten feet apart.

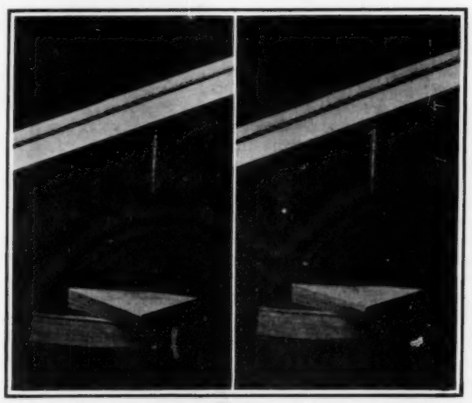
Considering the first mentioned series, *A* (⅕ second) is a print from a very good negative; details of envelopes, mercury vapor tube, and lamp support are entirely satisfactory. *B* (5 seconds) presents no novel features, though obviously over-exposed. *C* (20 seconds) shows a darkening of the lamp tube, indicating that development of the original film resulted in a positive instead of a negative, in so far as the brilliant tube is concerned. *D* (1 minute) indicates a strong positive of the tube, while all other less brightly illuminated features develop into the usual negative. *E* (5 minutes) shows the reflector above the tube developing positive. *F* (15 minutes) shows the tube support and the top envelope developing as positive. *G* (2 hours) shows every feature of the film a positive except the shaded edges of the stack of envelopes.

Turn now to the other series which was developed *in the light*. *a* (⅕ second) is a print from a negative so fogged in development as to show no picture at all. *b* (5 seconds) is a print from a fair negative. *c* (20 seconds) shows the tube a pronounced positive. *d* (1 minute) indicates an intense positive of the tube. *e* (5 minutes) is of unusual interest in that the envelopes are registered almost at that critical stage where negative changes into positive. They developed as very slightly positive. The reflector above the tube develops as a positive instead of a negative, and the lamp support is faintly positive. *f* (15 minutes) has developed into a clear-cut positive, though not so pronounced as *g* (2 hours).

A comparison of the two series shows that pronounced over-exposures developed in the light yield superior pictures to similar over-exposures developed in the dark. This arises partly from the obliteration from the photograph of under-exposed details, due to fogging during development of those under-exposed portions. Thus *f* and *g* show none of the irrelevant details that appear in *F* and *G*. Furthermore, development in the light seems to hasten the transition stage from negative development to positive development.

Now *g* is just as good a picture as *A*, although the film from which *g* was printed was exposed *36,000* times longer than the film from which *A* was printed, being developed in the light instead of the dark. Of course, the one picture is a positive, the other a negative. To make *g* look like *A*, the film of *g* was used to make a contact print on a lantern slide plate. A paper print was made from the latter, and the result is shown in the accompanying illustration, beside *A*.

The intensity of the light present in light-development is an important factor. A rather extensive investigation of development in the light was made many years ago by F. E. Nipher and was published in the Transactions of the Academy of Science of St. Louis in 1901. The results of that research are intensely interesting but are not widely known.

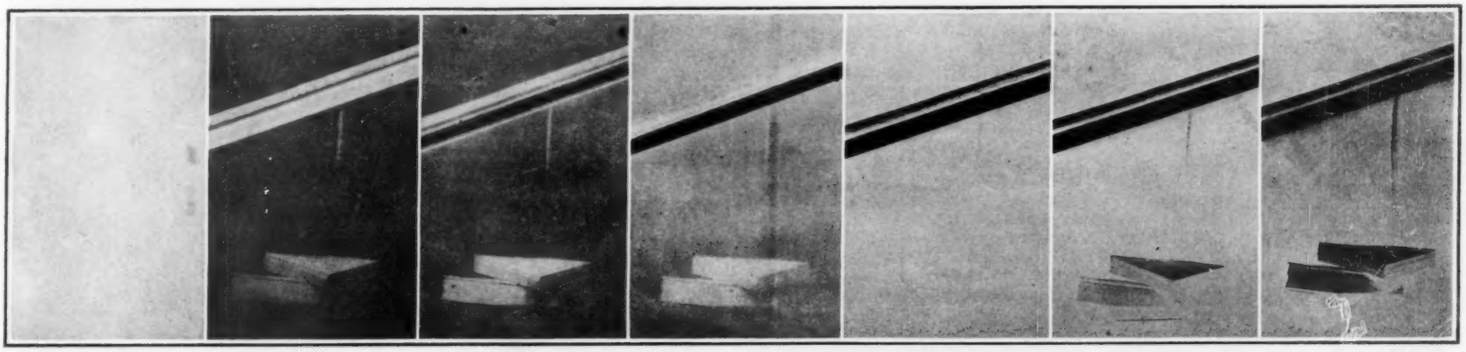


One of these pictures is the negative A, exposed for 1/5 second; the other is a contact print from the positive film g which had two hours' exposure and was then developed in full light. Who can say which is which, or which is the better picture?

New Method for Revising Copper Map Plates

WE all know that at times considerable difficulty is experienced in erasing a few words from a letter written with ordinary ink or by typewriter. How much more difficult and expensive is the erasing of some of the minute details from the plate used in printing an elaborate chart or map, such as those issued by the Coast and Geodetic Survey of the Hydrographic Office of the United States Government. Such charts, however, are only valuable if they are kept up to date, which means that revisions must be made quite frequently. The Bureau of Standards was, therefore, asked to aid in the solution of this rather difficult problem, and a method has been devised for altering small portions of these plates which seems likely to be highly successful. The principle is very simple and consists of removing metal from or depositing it upon the plate by electrolytic means. In brief, the process consists in directing a stream of the electrolyte, in this case a copper sulfate solution, against the surface of the plate in such a way that a current passes from the anode contained in the projecting apparatus to the plate which forms the cathode. The metal then deposits only upon those points at which the stream of liquid is directed and not over the rest of the plate, even though the stream of solution may subsequently flow over it.

In the practical application of this process to the correction of map plates, it has been found desirable first to remove the engraved parts to be altered, as it was difficult to get proper deposition of the metal in the bottoms of sharp lines. This removal has been accomplished by using the same apparatus with a reverse current whereby the copper from the particular spot is dissolved to any desired depth, after which the current is made to flow in the usual direction, whereupon copper is deposited over the surface in a dense adherent form which can be readily polished to a smooth surface and engraved.



a—1/5 second *b*—5 seconds *c*—20 seconds *d*—1 minute *e*—5 minutes *f*—15 minutes *g*—2 hours

Identical exposures were used with these as with the corresponding members of the first series, but the developing was done in the light, half-way between two 16-candlepower lamps placed ten feet apart

Building a Railroad in the Frozen North

Alaska Linked Up with the World by 500 Miles of First-class Railroad

WHEN President Harding officially opens the Government railway in Alaska, it will mark the completion of an unusually difficult feat of railway construction. So far as mileage is concerned, the road does not compare with the world's more notable systems. But in respect to the engineering skill that was put into its location and the constructive difficulties encountered in building it are concerned, it certainly takes rank as a notable enterprise.

This steel arch bridge is characteristic of the first-class construction of the Alaskan Railroad

It must be remembered that when this railroad was started, Alaska was little more than a wilderness. All the supplies had to be brought by steamer from Seattle. There were no roads to transport them, and no place ready to receive them. Throughout a large part of the year, frost made the earth as solid as rock, and pick and shovel could make but little impression. Glaciers hundreds of feet high and broad in proportion barred the way. Labor was difficult to obtain, since the Indian natives were unfit for such work and the lure of gold finding was too strong in competition with the comparatively modest returns of day labor on the railroad. Furthermore, natural obstacles such as could be found nowhere else stood in formidable array against the engineers. Mountain streams had the disconcerting habit of changing their beds overnight, flooding the tracks which had been dry roadbed the day before, and leaving the bridge that had been thrown over a stream inhospitably high and dry.

The road runs from Seward, on the seacoast, to Fairbanks, a famous mining town in the interior, the distance being about 500 miles. Seward, named after the man who negotiated the purchase of Alaska from the old Russian Empire, is one of the best harbors on the Pacific, being open all the year and completely sheltered. It has great possibilities, not only as the future port for the Alaskan Empire, which is certain of a great development, now that it has railroad facilities, but as the nearest port to Asia, and the terminus of a vast ocean trade.

Through Kenai Peninsular, with coal deposits everywhere and enough coal thrown upon the beaches to serve for the use of the inhabitants, the road goes north to Anchorage, a prosperous city which has been built up in the last few years covering the construction of the railroad. This stretch of the line was one of the most difficult. Mountain streams had to be spanned and the piers of the rivers had to be protected against the accumulation of ice and the succeeding thaw, when many tons of ice would be hurled in a heavy bombardment against these piers. In one place the roadbed was laid on a river bed between two glaciers. That portion of the line has been described as a succession of trestles and tunnels following each other with such rapidity that the high cost of the line is readily explained.

As the road was developed around the mountains and hills, it was necessary to guard against the avalanches that sweep down so disastrously over the frozen ground. Miles of sloping snowsheds were built over the tracks to pass the downrushing masses of material over the tracks and into the gorge below.

From Anchorage the line, extending northward, passes mountain lakes of surprising beauty, but bordered with stretches of marsh land that present a serious problem for the railroad builder. It then traverses Mount McKinley National Park, which is named after the loftiest mountain in America; and after leaving the park, the line enters the so-called "tundra," a huge stretch of marsh land which, when drained, will make excellent land for wheat growing. Today it is almost impassable, and calls for much ingenuity and labor to build and maintain a roadbed across it. Finally, after crossing many rivers, the road reaches the Nenana River, a tributary of the Yukon, and nearly as broad as that great stream itself. Here the town of Nenana sprang up, almost overnight. It became one of the leading cities of Alaska. After bridging the river, the line was carried to Fairbanks, its interior terminal and the center of a rich mining and farming district, in which grow products which few people believed could be grown so near the Arctic Circle.

Such is the Government Alaskan Railway. Its value can scarcely be overestimated. It opens up a land of opportunity which is as large as our whole Atlantic seaboard, coupled with two of our central States. Its resources are extraordinarily varied, far more so than is commonly understood. For today Alaska is growing wheat, vegetables and general farmyard products, is raising chickens and making its own dairy products. Millions of acres which with a little care can be made to yield good crops, are today lying fallow. As to the other resources of Alaska, it is rich in fisheries and has a flourishing fur industry. Gold is, of course, the product which has made Alaska famous. Hitherto, placer mining has served to get at most of the gold which has been produced; but with the development of the railroad system, mining activities will be directed to the deeper lying ore. Hitherto, Alaska has been obliged to import its fuel. Henceforth, the great virgin coal fields will be opened up. The lumber resources also are very great. Tall timber covers the southeastern portion. Elsewhere is wood for pulp in unlimited quantities.

Left: The caterpillar truck proved invaluable in hauling supplies and materials. *Center:* From bridge to tunnel, showing the costly character of the work. *Right:* Deep cut and lofty fill bring the road to a river which must be bridged

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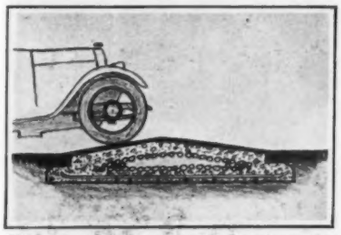
BY taking a little trouble, when a paper first comes to hand, it may be preserved to form a permanent and valuable addition to the reading matter with which everyone should be supplied. We furnish a neat and attractive cloth board binder, which will be sent by mail, prepaid, for $2.00. It has good strong covers, on which the name SCIENTIFIC AMERICAN is stamped in gold, and means by which the numbers may be securely held as in a bound book. One binder may thus be made serviceable for several years, and when the successive volumes as they are completed, are bound in permanent form, the subscriber ultimately finds himself, for a moderate cost, in possession of a most valuable addition to any library, embracing a wide variety of scientific and general information, and timely and original illustration.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



This hump, built into the road on the approach to a grade crossing, forces the speedster to slow his pace

Making Them Slow Up

BECAUSE of the large number of fatal accidents at grade crossings which have occurred in the State of Tennessee a new form of grade crossing approach has been installed at danger points. Owing to their resemblance to the familiar water bars found so profusely on hilly country roads, these are known as "thank-you-mams." They are made of concrete at the approaches of grade crossings. These humps, which rise for six inches above the level of the roadway, are placed 100 feet from the track and suitable warning signals are placed both in front of the hump and at the crossing. It is impossible to take these humps at high speed without seriously damaging the car, so that the natural result will be to force the reckless driver who is bent on trying conclusions with the train to slow up or smash his machine. And, at the worst, he won't smash it as badly on the hump as he would on a moving train.

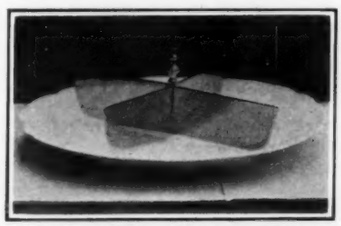
The Cyclist's Baby-Carriage

FRIEND Wife and friend Husband succumbed to an attack of wanderlust, and planned a cycling trip; but the question arose what to do with the ten-months-old baby. But friend Husband was a competent British mechanic, and he solved the problem in short order, so that baby could go on the trip, too. A hammock was firmly placed between the two bicycles, and the infant securely fastened in, swinging to and fro as its parents pedalled. They were picked up by our photographer as they passed through a small town in Bucks.

Baby goes a-cycling

Four Plates in One

THOSE of us who patronize up-to-date eating places are familiar with the square plates, usually ornamented in blue and listed on the menu under the head of Blue-Plate Specials, on which four or six different meats and vegetables are served in combination, yet unmixed, each article confined to its own compartment on the plate by the ridges which divide the latter off. This is all very well for the restaurant which makes a specialty of this sort of service; but for household use it is not practicable to have a plate which is good only when such combination orders are to be served. So a German inventor has made the partitions separately from the plate, in the form of a metal cross. The bottom of this is cut to fit the contour of the ordinary dinner plate. Tonight



Simple attachment that enables a plate to do quadruple duty

an ordinary roast can be served in the ordinary fashion, tomorrow night on the same plate with use of the metal divider a combination of vegetables, etc., can be dished up.

The Self-Contained Soldering-Iron

SOLDERING irons which employ no heat from an outside source, but utilize chemical reaction to produce a degree of heat of approximately 3000 degrees Centigrade in a few seconds, are now available. It is now possible, by way of example, with an exactly measured quantity of the reaction mixture, to heat a soldering iron, or a sad iron, in seven seconds to a point where it is ready for immediate use.

This soldering iron has a receptacle cast into it. In this is placed a small tin container holding the required mixture. The head of a special match is inserted through an opening in this container or briquet, and the wooden portion broken off. A perforated lid is then closed over the receptacle and the protruding match-end lighted. Instantly an intense white glow appears through the holes in the lid and the iron is ready for use. The heat from this one application lasts about ten minutes, after which another charge can be immediately lighted and the operation continued. After the first heating, the duration of heat under one charge is increased 50 per cent.

As prepared for the trade, the iron and a supply of the briquets and matches are housed in a compact, metal-lined box, with hinged lid and handle for carrying. So convenient is this arrangement that the charge can be set off in the box in the house, barn, office or living room, with no danger from sparks, and no more smoke than a whiff from a pipe. While in use there is no flame—nothing but a glowing mass within the receptacle. This outfit is particularly handy for the householder or the mechanic who has quick repairs to make. Owing to the absence of the fire hazard it may be used about the garage, barn, shop or house or on the airplane, automobile, or motor boat, with entire safety.

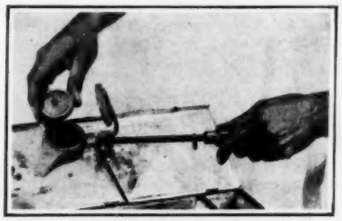
Post Office a la Subway

GOVERNMENTAL dignity in Germany appears to be a total loss, if we are to judge from the remarkable picture herewith. This is not the gate-house to an amusement park; it is a post office sub-station in Munich! Instead of locating these establishments in drug stores as is done in America, it is the German custom to erect kiosks for them, not dissimilar from those which mark our subway stations; and space on the walls is then sold for advertising purposes. The German buyer of advertising seems to be pretty thoroughly on the job, judging from the showing which he makes on this particular station.

The New Astronomy

BEFORE the invention of the telescope not more than about six thousand stars had ever been seen by human eyes, and less than half this number at any one time. The small telescope, with an object-glass an inch or so in diameter, used by Galileo in 1610, brought within the range of vision stars down to magnitude 10.5, numbering about five hundred thousand. The 60-inch reflector of the Mount Wilson Observatory, Pasadena, reveals stars of the 18th magnitude, and the 100-inch carries the sounding-line still further, while with both instruments many stars can be photographed which the eye cannot see directly, the photographic limit with four or five hours' exposure being about the 20th magnitude.

The expansion of the stellar universe as regards the number of stars in it which can be seen or photographed represents, however, only a small part of modern astronomical discovery. The test of a telescope is its resolving power, and this is expressed with sufficient accuracy by the relation $5''/d$, where the numerator is the normal angular limit of the object-glass in inches. The separating power of the 36-inch refractor of the Lick Observatory is thus 0".14, and that of the 100-inch of the Mount Wilson Observatory 0".05. By the use of the interferometer, the latter limit is reduced to 0".02, and this increase in resolving power was established by observations of Capella. More than twenty years ago this star was found by Campbell and Newall to be a spectroscopic binary (that is, to consist of two stars in motion about a common center of gravity and so close together that the system is known to be duplex only by detecting differences, due to orbital movement, exhibited by the composite spectrum), and



The soldering iron that acts as its own stove

The latest style in German post-offices

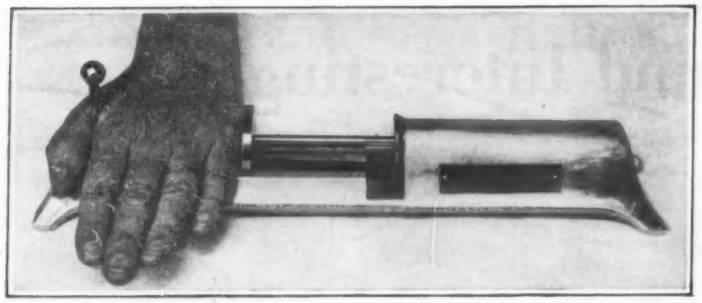
determination of the orbit showed that the separation of the components could not exceed 0".06. It was, therefore, within the theoretical limit of separation into its components by the use of Michelson's interferometer on the 100-inch telescope of the Mount Wilson Observatory. Observations made at the end of the year 1919 and the beginning of 1920 confirmed the accuracy of this conclusion, and the distance between the two stars of the pair was found on several occasions to be about 0".045.

Measurements with the 20-foot interferometer on December 13, 1920, gave an apparent diameter of 0".437, which is as striking a confirmation of theoretical deduction by observed result as that represented by the discovery of the planet Neptune. The parallax of Betelgeuse is uncertain, but there are reasons for believing it to be about 0".02, which would make the diameter of the star about 215,000,000 miles, or 250 times greater than the diameter of the sun. Antares has similarly been found to have a diameter of 400,000,000 miles, and Arcturus of 21,000,000. These stars are in an early stage of stellar evolution—attenuated masses of matter low down on the ascending side of the temperature curve of Lockyer's meteoric hypothesis—and from "giants" they will be transformed to "dwarfs" as they contract and increase in temperature.—*Abstract from Nature.*

Cutting Even Slices

THIS device will be a real aid to anybody who has struggled many a time with a loaf of bread in the attempt to obtain a number of slices of the same

Doing away with the stepmother slice



Fitting gloves by machine

thickness. When the board is not in use the cutting frame folds down and the board can be easily put away in a drawer. By moving the swinging gage against which the end of the loaf rests it is possible to vary the thickness of the slice.

Flashlight Without a Battery

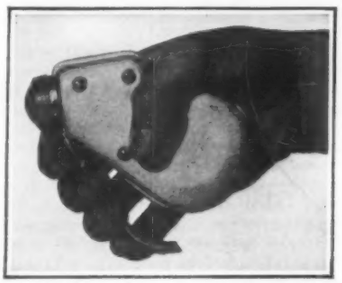
AMERICANS are familiar with giant electrical power plants. Great size no longer surprises in this field. But now comes what is possibly the smallest real electrical generator in practical use. You can grasp the complete outfit in your hand, yet it will go on producing current, and light, for years.

In addition to the ingenious generating magneto, the rest of the construction of this new flashlight is unique and interesting. The mechanism is contained in a "pistol grip" aluminum case that just fits the hand. The fingers of the hand grip a broad lever or trigger which is geared to the magneto in such a way that when the trigger is pulled the magneto revolves rapidly and a bright light appears instantly in the bulb. This light has proved particularly useful for farmers, hunters and campers, who are not able to get new batteries when needed. It is no less useful to autoists, meter readers, firemen, watchmen and housewives, too.

A New Way of Fitting Gloves

HERE we have a glove sizer that does away with the old dirty tape measure. The hand is placed as shown and a reading of the exact size required is indicated on the scale just below the metal plunger. The plunger with the disk on its end when no hand is on the sizer is extended full length. As the hand is placed for sizing it will be pushed back into its housing just the width of the hand. It works against a spring, and is held tightly against the little-finger end of the hand.

A machine for making long and sensitive fingers



Flashlight with a generator instead of a battery

Multiple Oiler for Chassis Parts

A NEW multiple oiler for lubricating chassis parts is manufactured now. It comprises a number of pumping units equal to the number of places to be oiled, which are assembled in the oil reservoir and from which leads run to the bearings to be lubricated. The pumping units are operated by means of a pull-rod extending through the dash and instrument board, the oil reservoir being mounted under the hood. From the reservoir connections are made to all the points on the chassis requiring lubrication. The system enables the driver to lubricate every bearing while sitting at the wheel, either while driving or while standing in the garage. The system can be supplied for any chassis and with any number of leads.

One Cup of Coffee

IT is a difficult matter for the occupant of a kitchenette apartment to make a single cup of coffee. This new coffee maker does it, using the percolation process. Coffee is placed below the perforated section, which is the water spreader. Below this is a filter of silk fiber through which the made coffee filters into the cup. The filter holds back, with the grounds, the insoluble and gummy fats which tend to make coffee sour. It is this matter which makes coffee difficult of digestion for some.

Making Musical Fingers

LONG and supple fingers are closely identified with successful piano and violin playing. Not that the owner of such fingers is necessarily a prospective Paderewski, but simply that the musician of power must have the fingers. But if you have not got them, don't give up without a struggle; for here is a machine that may give them to you. It is the invention of Professor Ostrovosky, a prominent European musician. The hand is inserted in the machine as shown in the photograph, and pressure is applied in such a way as to stretch the bone and flex the joints, without pain or injury.

The Metal-Cutting Saw with Detachable Teeth

THE Franklin Institute recently presented to Mr. Samuel T. Freas the Edward Longstreth Medal in recognition of his invention of the interlocking-tooth metal-cutting saw. This award was made upon the recommendation of the Institute's Committee on Science and the Arts after a very complete investigation of the development of the inserted-tooth metal-cutting saw.

In presenting Mr. Freas to the Institute a member of the committee said:

"One often hears it said of a successful invention how surprising it is that no one thought of it before, it being so simple. In reality surprise should be expressed that anything so simple should have been thought of at all.

"In the present instance there has been produced a detachable-tooth saw for cutting metal, the success of which results largely from its remarkable simplicity. This simplicity of design is due to no mere chance, but has behind it years of concentrated application to the study of metal cutting.

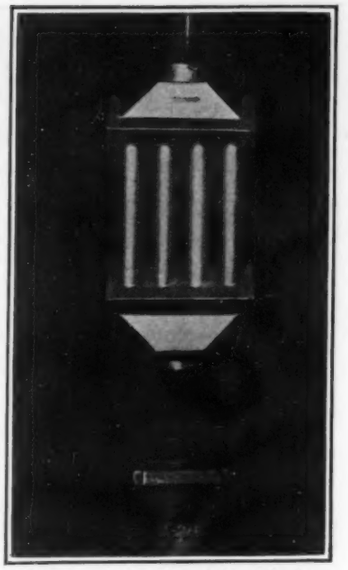
"The use of circular saws for metal cutting, while not new, is becoming increasingly extended. The inserted-tooth saw allows faster and more economical cutting, but the intense stresses set up in the teeth of a saw doing heavy work have made it a difficult problem to hold the teeth in place, and at the same time have them readily removable and replaceable. The medalist (Mr. Freas) has done this by a very simple but unusual combination of wedges."

Getting All the Heat

SUFFERERS from the coal strike may reflect that they are not alone in their plight. German domestic users have for several years been in much the same predicament, though from a somewhat different reason. There is plenty of fuel in Germany, but the average user cannot amass sufficient paper marks to buy it in the normal amounts, and hence has to go cold part of the time, and to spread the coal out thin.

One-cup coffee percolator

One result of this is that hardly a mail comes from Germany without one or more photographs of new and ingenious devices for economizing heat and saving fuel. The one which we illustrate is aimed at one particular manner of wasting heat which is extremely common in this country. Most of our heating stoves are set so close to the furnace that the smoke and other hot gases which are drawn out by the draft pass away without the slightest degree of utilization being made of them. Even when we have a stove at some distance from the chimney, we carry the draft from the fire-box to the flue by means of a single, large-diameter pipe which we permit to accumulate a heat insulation of soot.



A German device for catching the heat that usually goes up the chimney

The device which we illustrate is inserted in the pipe between the stove and the chimney. It replaces the single draft-pipe of large size by a number of such pipes, of much smaller size and hence of much greater combined radiating surface. When these are kept free of soot so that their propensity to give off heat is a maximum, the claim is made that the efficiency of the fuel burned is increased 100 per cent.

Two Connections From One Wall-Socket

IN the average home there is but one wall-socket connection in the dining room. To make use of more than one electrical device, connection must be made from the electrical fixture above the table. This means that several cords must be trailing over the table.

This portable, two-way connection rests on the table. Needing, of course, but the one cord to the one wall-socket, it provides the means of connecting in two toasters or ironers or what-not; and, of course, the idea can be extended to supply as many outlets for the one line as desired.

Two service connections from a single wall socket

The clothesline with a brake to check its accidental unrolling

A Brake for the Clothesline

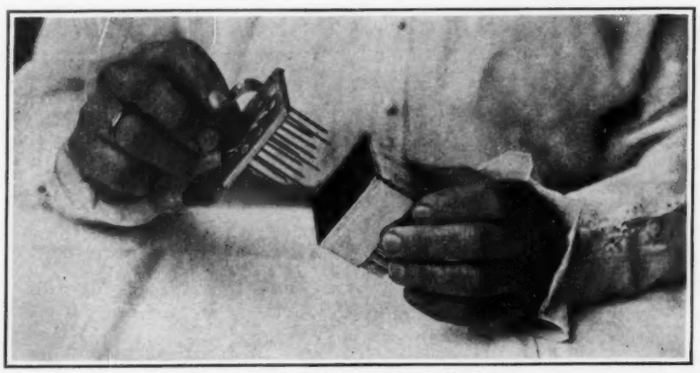
WHEN the family clothesline goes trailing in the dust or dirt, it frequently means that collars are soiled, as well as the rest of the laundry. The inventor has made the outer end of this reel handle revolve with the reel and it acts as a brake, preventing the line from being fed out too fast. The wire guide places every foot, of the 250 which the reel holds, in its own particular place. No twists or kinks get in the line.

The One-Man Top

THE one-man top has been the subject of many a jest, and in truth many of the tops to which this designation is applied require two or three people for their proper handling. One reason for this is that the ordinary top is far from rigid, and when it displays a tendency to collapse it is often necessary for it to have a guiding hand at several points too far apart for one person to cover. This particular obstacle to smooth operation cannot be met with the top illustrated, for it is quite rigid. Instead of folding up, it slides bodily around and down into the space behind the seat. It is, apparently, as strictly a one-man job as a shade or a shutter.

Tools for the Pastry-Cook

IN cutting cookies of any sort out of a sheet of dough, a die is necessary; and such dies in plain or fancy shapes are part of the equipment of every well-furnished kitchen. Somewhat less commonly seen, but still by no means rare, are forms for the pricking of perforated patterns in the tops of the cookies, of fancy cakes, etc. An ingenious German inventor now gives us the two in one; the pricker nests into the die when not in use, as shown in the photograph. Of course the plain rectangular shape is not prescribed; hearts, diamonds, or any other fancy outline desired may be had.



The latest dies for ornamental pastry

Runabout Lifeboats

LIFEBOATS arranged on the deck along rails, so that they can be run to that part of the ship from which launching is possible, are a feature of the Dutch steamer "Mecklenburg," which runs between Folkestone and Flushing. The steamer is so fitted that at all times there is lifeboat accommodation for all persons on board. All the boats, 13 in number, are placed on the boat deck. All but two are capable of being launched from either port or starboard; and all, without exception, can be launched in less than a minute. In this way it is anticipated that heavy listing, which more than once has prevented expeditious launching of all boats and has thus led to loss of life, will have no terrors for the "Mecklenburg" in the event of a wreck.

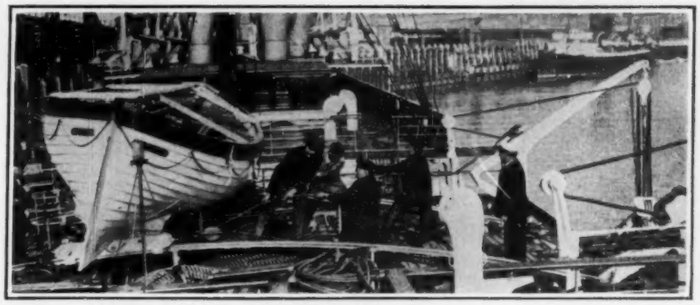
Dehydration

DEHYDRATION in the modern sense of the term may be defined as the process whereby perishable foods with or without previous treatment are subjected to the action of carefully regulated currents of air in which the temperature and humidity are controlled.

The method results in the food products gradually losing water, but without giving up their color or flavor or having their cellular structure impaired. Accordingly the dehydrated food will reabsorb water, swelling up to its normal size and appearance. When cooked it will have the same appearance, flavor and odor of freshly cooked material made from fresh vegetables.

Dehydration dates back to 1850, when Masson, a Frenchman, dried a large number of vegetables and fruits with a blast of warm air at temperature near 70 degrees Centigrade. Sometime later, Passburg of Berlin obtained excellent results with vacuum drying apparatus.

A real one-man top



Lifeboats that can be launched from any part of the ship

It was not, however, until the Boer War that products of this nature began to be manufactured on a considerable scale. During this period many thousands of pounds of dried vegetables, mixed so as to form a basis for an easily prepared soup, were produced in Canada and shipped to the British Army in Africa.

Stimulated by the possibilities of marketing products of this nature on a commercial scale, a number of Americans established factories in this country and by 1910 began to manufacture dehydrated vegetables and soup mixtures. These products, however, never became widely popularized.

The methods of dehydration employed at the present time are varied in details of procedure. All, however, are founded on the same basic principle, namely, to remove the water contained in and between the cells of the food so as to obtain a product which cannot spoil as a result of microbic or enzyme action.

The water taken away by these methods is only replacable water and so the nutritional value of the food has not been altered. Moreover, if dehydration is applied while the fruits, vegetables or animal products are absolutely fresh, the flavor-giving substances are preserved intact. In the best grades of dehydrated products the rate of evaporation is such as to bring about the removal of water without rupture to the cell walls.

By means of this process the weight of the food is reduced from 80 to 90 per cent and the bulk is diminished to one-fourth or one-sixth of the original volume. By means of compression the nearly dried material may be brought to a compact form. Not all the water is removed, the amount remaining varying, depending upon the character of the food, from 7 to 15 per cent. But sufficient is removed to concentrate the solutes to the extent of producing plasmolysis.

The manner in which the material is prepared influences to some extent the quality of the product. If the first temperature applied to the fresh material is too high, certain changes take place in many vegetables, giving them an appearance of scorched or scalded substances and diminishing their water-absorbing power. Accordingly, in dehydrating vegetables, the fresh material should be subjected to air having a low temperature and high humidity and gradually brought to a high temperature and low humidity.—*Abstract from article by Dr. H. W. Youngken in The Scientific Monthly.*

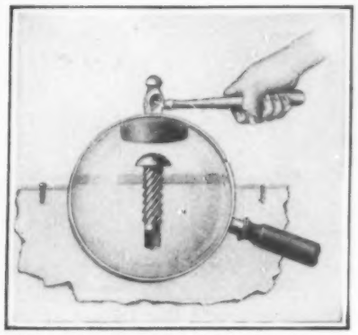
Better Chassis Lubrication Needed

MORE attention is being given to ways and means for providing better lubrication of chassis parts, or what is more to the point, decreasing to an absolute minimum the number of parts which require hand lubrication. There seems to be a general opinion on the part of many automotive engineers that the grease cup will in time disappear from the passengar car chassis. It is a nasty job to fill the ordinary grease cup and too often the grease is not forced to the surface it is intended to lubricate. A few car manufacturers and one or two parts makers have designed systems for feeding oil to all parts of the chassis requiring lubrication, but the cost and complication of these systems is a serious drawback to their general adoption. Devices arranged to feed oil by wick or as a result of vibration are promising, at least for certain applications, so long as they are made readily accessible for filling, cleaning and adjustment. Considerable study must be given to this subject before an ideal system will be developed.

Laprobe Inside a Footrest

AN interesting new automobile accessory is a combination footrest and laprobe for use in the tonneau of an automobile. As a footrest it appears to be a heavy metal cylinder, black japanned with satin finish, which is fastened to the floor of the car in the same manner as the ordinary footrest.

This 72-inch lap-robe goes within the 37-inch foot-rail



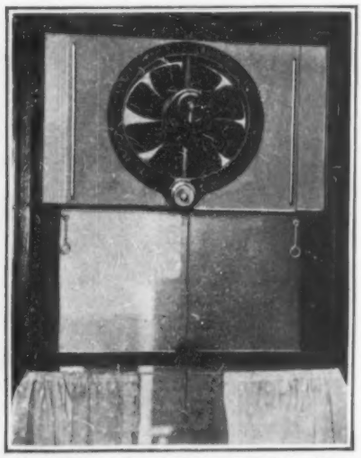
Screw for plaster walls that is driven with a hammer

When not in use it is folded over against the front of the rear seat, out of the way, and is placed in position as a footrest when needed.

On a spring roller inside this container, there is a heavy cravenetted, waterproof laprobe. Since the cylinder is only 37 inches long and the laprobe is 72 inches wide, the inventor devised a method by which 18 inches of cloth on each side of the robe is folded over and held together by fasteners. When the robe is rolled up, a metal eyelet in the leather end fits over a hasp on the cylinder and is locked with a padlock. Great cleanliness and accessibility are claimed for this new device.

Reversible Window Fan

VENTILATION of house kitchens and small rooms is greatly facilitated by the perfection of an adjustable sheet-metal fan frame which fits windows 24 to 34 inches wide and firmly supports a small ventilating fan. This frame, being adjustable, fits any ordinary window and makes possible quick installation, with a screw-driver and hammer the only tools required. Handles for raising and lowering the window, and which screw into the sash, are furnished with the frame as well as necessary bolts for holding the fan in the frame, screws, etc. No alterations, carpenter or electrical work are required in making the installation which can be completed by the man of the house in a few minutes. Fans are furnished with motors for either direct or alternating current, and tests have demonstrated that no more electricity is required than necessary for a 50-watt lamp. The fan, which is furnished with cord for attaching to a nearby lamp socket, has a reversible motor. The fan will exhaust hot, stuffy, stagnant air—with odors, smoke and vapors. Then by simply pulling a string the motor reverses and the fan brings in the fresh, out-door atmosphere.



Ventilating fan that is placed in the window and that works both ways

Driving Screws With a Hammer

THE problem of putting up bathroom fixtures, etc., on plaster walls is not always easily met. Nails do not grip; screws require too much pressure for driving them in, so that the hole is worn smooth before it starts to be used; glass-headed pins, sometimes offered, are weaker than nails and little more permanent. The screw shown herewith represents an effort to give a permanent grip with the plaster. A hole is bored in the wall slightly smaller in diameter than the screw. The plain pilot of the latter is inserted into this hole, and the screw-head is gently tapped with a hammer. The screw under this treatment advances, turning the while, and it is claimed that the thread thus cut in the plaster, because of the absence of destructive pressure in its cutting, stays sharp and continues to hold the screw.

A Radical Departure in Rail Production

A NEW development is approaching completion which promises radically to change present methods of making steel rails. One of the most difficult as well as essential steps in producing a rail is its straightening while still hot. When the new rail comes from the rolls, by which it is rolled to its final shape, it is more or less crooked. Present methods for straightening entail the use of what is known as the gag press—a very cumbersome, complicated machine and also very expensive to install and operate. There is another phase in its use which is also important—it has been found that in straightening rails by the use of this gag press certain strains are set up in the metal of the rail which often result in defects, and the final breaking of the rail.

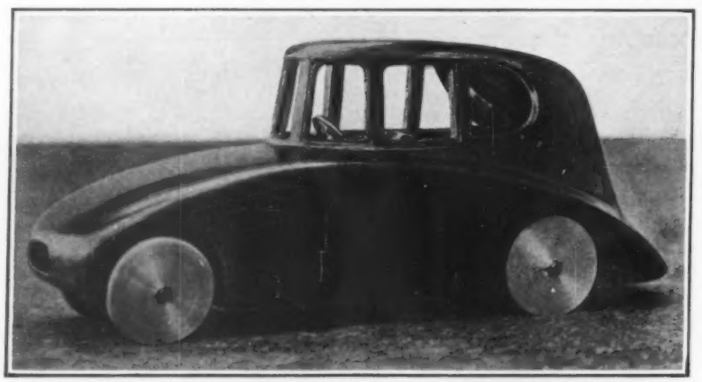
Extensive experiments, which have resulted in the new development referred to, have demonstrated that it is possible to straighten rails without the use of the expensive gag press. The striking thing about the new development is its simplicity and the wonder is that it had not been thought of before. It consists in suspending the rails while still hot from a sufficient height so that, as they hang, they are straightened by their own weight—much as a curtain or towel when wet is kept straight or flat if hung up to dry.

It is probable that this new process, which has passed the experimental stage, will soon be adopted by a large producer of rails at whose plant the investigation is proceeding. Some important details are still to be worked out. An evident conclusion is that its use will insure a better rail at less cost.

Ideal Automobile Lines

IT has long been realized that the current types of automobile body, from the point of view of air resistance, are far from being satisfactory. The first radical departure from the usual practice was made last year when a firm of German airplane constructors designed a body imitating the shape of a falling drop. A further improvement is now announced by P. Jaray, chief engineer of the Zeppelin Works, at Friedrichshafen, according to whose investigations neither a spindle, nor a torpedo, a drop, a boat, nor an airship on wheels, but one-half of a stream-line body, enclosing and encompassing everything, even the wheels, will afford the solution of the problem.

An interesting set of comparative tests has been carried out by W. Klemperer, on a suggestion by Mr. Jaray, in the large 3-meter wind channel of the Zeppelin firm. One of the striking results thus obtained is that the air resistance of ordinary types of body, destined for a standard chassis with engine placed at the front end, will remain practically constant, irrespective of any alterations made to the fittings, even the absence of a wind screen reducing the resistance only slightly, if the driver remains sitting erect. The greatest resistance is exhibited by a standard open car fitted with wind screen and having its passengers seated in the rear. A body slanting sideways in front and rounded off in the rear only slightly reduces the resistance. In fact, the air resistance of an enclosed car such as this will, at a speed of 60 kilometers (36 miles, roughly) per hour, entail more than 60 per cent increase in the power required to overcome the rolling resistance and gear losses, while the surplus power required at 70 kilometers is nearly 90 per cent and at 80 kilometers, upwards of 110 per cent.



The latest stream-lined car from Germany, where they are keenly interested in these models

Car bodies designed on the stream-line principle, *i. e.*, corresponding in shape to one-half of a stream-line body, on the other hand, only set up about one-third of the air resistance to be overcome by a standard enclosed car. The surplus power corresponding to the air resistance, accordingly, in the case of 60 kilometers per hour, is only about 20 per cent, at 70 kilometers only about 30 per cent, and at 80 kilometers only about 40 per cent of the power required to overcome the rolling resistance and gearing losses. The resulting saving of fuel is therefore from 30 to 40 per cent of the consumption required for the same distance in the case of an ordinary up-to-date body. Inasmuch as the air resistance is thus reduced to about one-third, the maximum speed can, of course, be raised considerably in the case of the stream-line car, and the same applies to the gradients to be negotiated on a given gear. The saving of fuel will make the small car a cheap vehicle for everybody.

Stream-line bodies can be fitted with no material alteration to any existing standard chassis having its engine placed in front.

Suitcase that is easy on the arms

The Strolling Suitcase

FIRST prize for the month's trick invention goes without dissent to the device pictured herewith. One could be afforded any reasonable number of guesses with considerable assurance that one would not guess right. The thing is—a suitcase! The German inventor had got leg weary and arm weary so often from carrying the conventional suitcase that he designed one requiring no aid from its owner in the little matter of resisting the pull of gravity. They do tell that the inventor of the umbrella was mobbed when he made his first public appearance under his portable roof; perhaps in a somewhat gentler age the perambulating suitcase will not bring any such treatment as this to the man bold enough to introduce it to the public gaze, but we are sure it will make a sensation. Also, it will give a new excuse for tardiness; before starting for the station, what calamity to discover that one's suitcase needs a new bearing, or that it requires oil and there is no oil in the house, or that it has a flat tire!

The Golf-Ball Rake

WHAT golfer has not hung by his teeth and eyelashes to a tree or bush while he made wild stabs in the pond with his longest-shafted club, in the effort to retrieve a ball that was just an inch beyond his reach in the water? Or what one has not been forced to climb a fence to rescue the little white spheroid from an out-of-bounds lie that was similarly out of reach? A Washington golf instructress, Mrs. L. M. Callison, has taken out patents on a "golf-ball rake" which goes in the bag like any club, but which provides a much more reliable means of recovering the ball from an inaccessible place. The head folds down along the shaft when the rake is in the bag; when it is in use, the head snaps into operative position and gives a much surer means of bringing home the ball. Also, the shaft can be of any extreme length desired, and can even telescope—which is not the case when the driver or the brassie is used for the purpose of the rake.

Salvaging truant golf-balls with a special rake

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

A Disinfectant Lamp

IN *Comptes rendues*, 1922, Vol. 174, pages 1471 to 1474, there is described a lamp, which may be used to disinfect rooms and which produces the disinfectant agent in the course of burning. The particular disinfectant is formaldehyde and this is produced by the combustion of methyl alcohol. To this end two types of catalysts are used—namely, compressed lampblack, containing 20 per cent of copper oxide, and, secondly, silvered asbestos board. The heat from the compressed catalyst in the first case or from the gauze container of the catalyst in the second case is used to vaporize the methyl alcohol as it is brought up from the container by a cottonwool wick. The lamp uses about 100 grams of methyl or wood alcohol per hour, and the yield with the first type of catalyst is 30 per cent and with the second type 35 to 40 per cent (in one case a yield of 45 per cent was obtained). The second type of catalyst needs to be heated to a red heat in an external flame before use, but it gives the best results, and has been adopted for use in disinfecting surfaces.

Tin Foil Made Brittle by Aluminum

AN investigation, made in Germany and published in the *Mitteilungen der Kaiser Wilhelm Institut fuer Metallforschung*, has shown that the reason why certain kinds of tinfoil are brittle and break easily when bent is that they contain aluminum. Only 0.25 per cent of this metal is sufficient to produce the bad results.

Fats Produced by Bacteria

IN Austrian Patent No. 88,816 there is described a process of making fats by the action of certain acid resistant bacteria on nitrogenous refuse matters. Such materials as fruit and vegetable pods are used for this purpose. The bacteria are allowed to develop in the mass, and then the raw fat is removed by extraction.

Carbon Black, a Natural Gas Product

CARBON black is made by burning natural gas in lava tipped burners in the absence of sufficient air for complete combustion and allowing the flames to impinge on a cold surface, such as the smooth under-surface of steel channels. The deposited carbon is then scraped off. Carbon black is made almost exclusively in the United States. It is estimated that about 40 billion cubic feet of natural gas are consumed annually in this manufacture. The industry started in West Virginia, but has now moved further westward and is centered at the present time in Louisiana. Wyoming, Oklahoma, Montana and Kentucky contain many carbon black factories. These plants are of temporary construction only, so that when the supply of natural gas peters out in one locality they can be easily moved to the next.

Carbon black is used largely in the manufacture of solid rubber tires. About 20 million pounds are consumed annually in the United States for this purpose. This is perhaps the most important use for the pigment. It is also used in large amounts in the manufacture of printers' ink and of stove polishes. About 10 to 12 million pounds are used annually for the former purpose and from 4 to 5 million pounds of the pigment for the latter purpose. The product also enters into the manufacture of black and gray paints, black varnishes, phonograph records, tarpaulin, black leather, artificial stone and insulating compositions. In normal times the United States exports about 10 million pounds of carbon black annually.

New Substitute for Coal

FROM Sweden comes the report that peat briquettes, which have been impregnated with shale oil, make a very good substitute for coal. The process of impregnation is simple and consists merely in mixing the powdered peat with 10 per cent by weight of shale oil and then briquetting. The price of such briquettes is stated to be one-half that of anthracite coal.

Naphthalene As an Engine Fuel

AN article with the above title appeared in the *Schweiz. Chemiker Zeitung*, 1922, pages 542 and 562. In this article it is mentioned that by mixing 90 per cent benzol with 10 per cent of dekalin the freezing point of benzol is lowered to minus 3 degrees Centigrade. When the proportions are 70 per cent benzol and 30 per cent dekalin, then a product is obtained which does not freeze in the carburetor and tanks at the ordinary winter temperatures. Both the cost of the fuel is reduced and the calorific power increased in comparison with gasoline.

Oxidation of Paraffine With Peroxide of Nitrogen

IN the Swiss journal, *Helv. Chim. Acta*, Vol. 3, page 721, there is described an investigation on the oxidation of paraffine with peroxide of nitrogen. A yellow, semi-solid product is obtained, containing about 10 per cent of fatty acids soluble in water.

New Petroleum Cracking Process

GOVERNMENTAL officials in France have been investigating a new process of cracking petroleum, shale oil and other heavy oil residues. This process, contrary to the others that are in common use, will produce gasoline in one operation while the others are all two-stage processes. The product is manufactured at a high yield and is perfectly miscible with alcohol, which is an important point in preparing compound fuels. *Le Courier des Petroles*, July 8, 1922.

Making Rubber With Electricity

RUBBER is derived from the rubber tree in the form of a milk sap. When the latex, as it is called, is subjected to the action of certain chemicals, as acetic acid, etc., the sap is coagulated much in the same manner that milk curdles when acid is mixed with it. The product formed is the raw rubber of commerce, as it is shipped into the rubber mills for conversion into vulcanized articles. A new method of coagulating the rubber latex has been devised, according to the *Gummi Zeitung*, Vol. 35, pages 659 to 660. It has been determined that the particles of rubber in the milky sap are charged with negative electricity. When a current of electricity is passed through the latex, the rubber particles are collected at the anode, while the milky sap clears up at the cathode. Porous vessels filled with carbon were used as the electrodes. A 110-volt current produces quick coagulation.

Sulfur Dioxide Bleach for Foods

THE use of sulfur dioxide to bleach foods has always been fraught with the subsequent difficulty of completely removing all traces of the bleaching agent from the food. In a patent obtained by Irving Hochstadter (United States Patent No. 1,412,513), hydrogen peroxide is added in sufficient amounts to the food to oxidize the excess sulfurous acid and also to exert a certain amount of bleaching action itself. The bleaching of gelatine is accomplished in this manner very effectively, better than by the use of either bleaching agent alone. Cherries may be bleached with gaseous sulfur dioxide or a solution of the gas or a salt like sodium sulfite. A large number of foods, such as fruit products, syrups, nuts, potatoes, apples, cereals, etc., can be treated in this manner. If there is any excess hydrogen peroxide remaining in the food after the oxidation of the sulfur dioxide, this is not in any way detrimental, as it breaks up immediately to form water and oxygen gas.

Vegetable Oils From Wastes

THERE are many edible and industrial oils in use at the present time and it would appear that most of the available sources of these products have been exhausted. But the investigations of the Department of Agriculture have proven otherwise, that valuable edible oils can be obtained in paying quantities from waste products and from seeds, such as the sunflower, not yet grown to any great extent in this country. Tomato seeds are recovered in large quantities. An oil can be extracted from these seeds which is suitable for food oil. The yield is about 18 per cent of the dry weight of seed by pressing, and 20 to 22 per cent if a solvent is used. Oils obtained from brown mustard and charlock are of use in the manufacture of soap and technical products. Oil from the sunflower seed can be used for food and in the manufacture of soaps and Russian varnishes. Okra seed oil resembles cotton-seed oil closely and can be used for most of the applications to which the latter is put. Cohune nut oil resembles cocoanut oil and can replace it for many purposes.

Galalith in Rubber Making

GALALITH is an artificial product, made with a casein base, and used in the place of natural ivory. For example, the keys of pianos are made from this material. In the course of this manufacture there is a considerable amount of dust and waste galalith accumulated, which can be used to good advantage in the compounding of rubber. The dust is all of one color and makes a very good filler. When galalith is subjected to the action of ammonia gas it is changed into a gelatinous product. The formaldehyde, which it contains and which was used in its manufacture, is converted into hexamethylene tetramine and the caseine is changed into the soluble form. The mixture that is obtained in this manner is an accelerator of the vulcanization of rubber, due to the fact that the ingredients in the mixture form a certain amount of thiourea at the temperature of vulcanization. It can be used to good advantage for this purpose. Further detail will be found in *Kunstoffe*, 1922.

Hydrogenation of Maize Oil

AN interesting description of the various processes employed in the hydrogenation of maize oil is given in *An. Asoc. Quim.*, Argentina, Vol. 9, page 86. It is noted that when nickel or platinum is used as the catalyst the oil must be thoroughly dehydrated before hydrogenation.

Metaldehyde As a Fuel

A FUEL has been made by a Swiss firm from metaldehyde, a substance which up to the present time possessed only scientific importance. Metaldehyde is made on a commercial scale through the synthetic production of acetaldehyde from calcium carbide. The product must be compressed strongly into suitable shapes before use. The compression reduces its inflammability considerably and makes it safe to use in the household. *Chemical and Metallurgical Engineering*, August 2, 1922, page 216.

Sensitive Copper Reagent

AN alkaline solution of phenolphthalein is used to detect the presence of copper in one part per 100 million parts of water. The presence of copper is indicated by a clear rose coloration of the solution.

Electrical Control of Alkalinity of Feed Water

THE apparatus, which is used to control the alkalinity of feed water introduced into the steam boiler, is based on the principle of the Wheatstone bridge. On the one hand the current passes through the feed water and on the other side it passes through a resistance. During this time a very sensitive galvanometer indicates the ratio between the alkalinity of the feed water and the voltage. Hydrogen and calomel are used as electrodes in porous vessels. The apparatus is claimed to give very good results. *Chemiker Zeitung*, 1922, page 655.

Tar for Cement Protection

INVESTIGATIONS have been made on the use of gas tar for the purpose of impregnating cement to protect it against various influences. The liquid gas tar that is used for this purpose is obtained as a by-product in the manufacture of gas, and is very cheap. Both cement and mortar absorb this material very readily. The cement that is treated with this product can be stored for six months in a strongly alkaline solution without any bad effects, while untreated cement was badly injured by this treatment. The impregnated samples did not exhibit any loss in strength or durability.

Our Startling Automobile Traffic

By Charles Evan Fowler

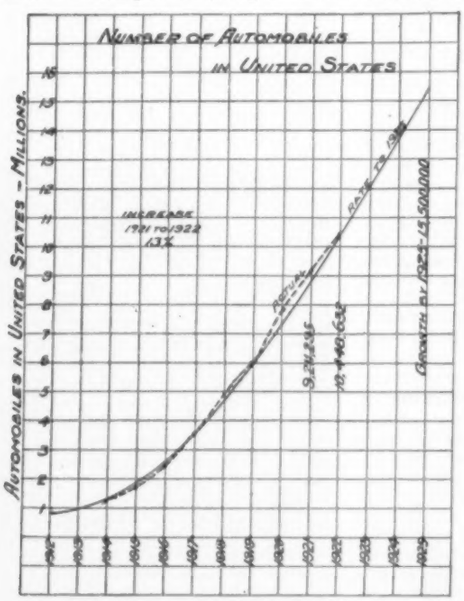
THE traffic surveys for the new Detroit-Windsor Bridge, to connect Detroit, Michigan, and Windsor, Ontario, Canada, have developed some very startling figures for the consideration of the builders of highways and bridges. The graphic diagrams herewith show the growth of the number of automobiles in the United States, Michigan and Ontario since 1912. Those of us who are accustomed to travel over wide stretches of the continent have sensed, in a vague way, that the problem of handling the automobile traffic has reached a very grave stage, but the figures when put in graphic form, or as a picture to be looked at, cause us to wonder what can be proposed for handling it, five or ten years from now.

The total number of machines for 1922 of 10,448,632 represents an increase of over 1000 per cent since 1912, and careful estimates by experts show that about one-half of this number were en tour during the past summer. So great became the crush at the Niagara bridges during the Labor Day Holidays that the toll takers and officials became exhausted. The increase to 1925 is quite sure to represent a total of automobiles for the entire United States of over 15,500,000 machines, and in less than seven years the number will be doubled! Just how do the States, counties and municipalities that are sleeping on the matter of providing adequate facilities expect to control such a flood?

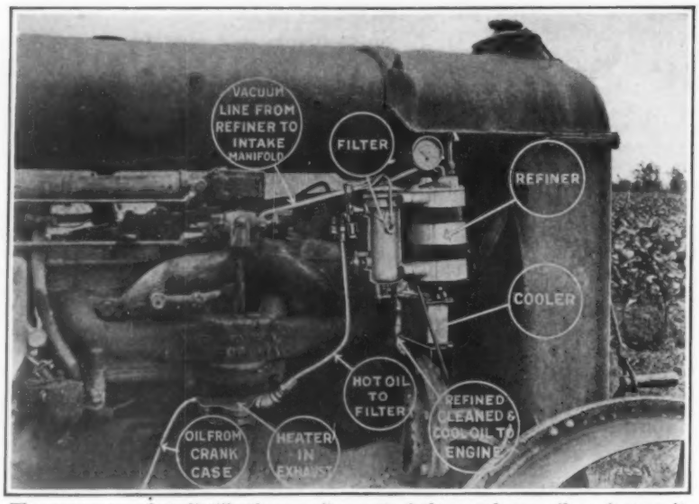
Those that have visited the city of Detroit recently have seen what is happening at the home of the automobile. There, the rate of increase is on an average about double that of the balance of the country, and that rate is nearly equaled by the rate of increase in Ontario, the automobile-fabricating suburb of Michigan. The ferry boats across the Detroit River are so inadequate that people do not try to cross with automobiles, but leave their machines and go over on foot. Instead of being able to take advantage of the short cut across Ontario, the tourist often ships his auto by boat to Cleveland or Buffalo, or else takes the route around the south shore of Lake Erie, which is longer by 110 miles.

The highways have become too narrow to accommodate the ever increasing number of automobiles. The regulation of this fast-increasing traffic is becoming a problem too great to be coped with by the city authorities, and it must be put up to the expert to find the way out of the tangle. Fortunately we have, in our police forces all over the country, men of a nationality that is very quick witted and that has imagination; but they are not omnipotent and often do not have the proper backing from the higher officials. Perhaps the best regulation is to be found on Fifth Avenue in New York City, and that should be studied by all those interested in the problem; and we must all be interested in the very near future. But when such widespread congestion results as comes about with the great number of machines in Detroit, it may well cause the wisest to pause and ponder what is best to be done, and to consider ways that a few years ago would have been thought revolutionary. The automobile becomes almost useless for the handling of downtown business traffic, and it is only a question of a short time until we shall come to the two-story street, one way streets, and streets on which automobile traffic shall be absolutely prohibited; at least during certain hours.

The roadways on our bridges, and in tunnels, if they can be made to carry automobile traffic safely, must be made for not less than three lanes of traffic in each direction for city bridges, and for three or four lanes total for country bridges. In fact the handling of modern traffic is in every sense a man's-size job, and one where vision must be substituted for dogma. What the future will bring forth with such wizards as Ford to keep on reducing the cost and price of automobiles, no one can predict; but it is safe to say that within the next decade all of the American continent at least will be on wheels. And just as confidently can we predict that each summer will find an increasing number roaming over the country for the vacation, until within five years some 10,000,000 machines must find room on our country highways, with and alongside the regular traffic. This means that cutoffs must be constructed around the cities for tourists, as has been done on the Lincoln Highway at Chicago and less notably, at Philadelphia; and that such traffic must be led away from the congested portions of all of our cities and towns.


NUMBER OF AUTOMOBILES IN UNITED STATES
AUTOMOBILES IN UNITED STATES - MILLIONS
INCREASE 1921 TO 1922 13%
9,214,235
10,448,632
GROWTH BY 1925 - 15,500,000

Automobile increase of 1000 per cent in 10 years in the United States



The apparatus that distills the gasoline out of the crankcase oil as fast as it leaks in, and returns it to the intake to be burned

Keeping the Gasoline Out of the Crankcase

THE automobile engine was designed when no one would have supposed that there would ever be any difficulty in supplying it with volatile and dry fuel. But the automobile industry has been making these engines in such numbers that the petroleum industry has been left behind. The only way in which it is possible for all of us to have gas for our cars is for all of us to accept gas of a lower grade than would have passed muster ten years ago. This can mean but one thing: More and more fuel is carried into the cylinders in liquid form, to leak through into the crankcase and dilute the oil. This dilution is today one of the serious problems confronting the automobile designer.

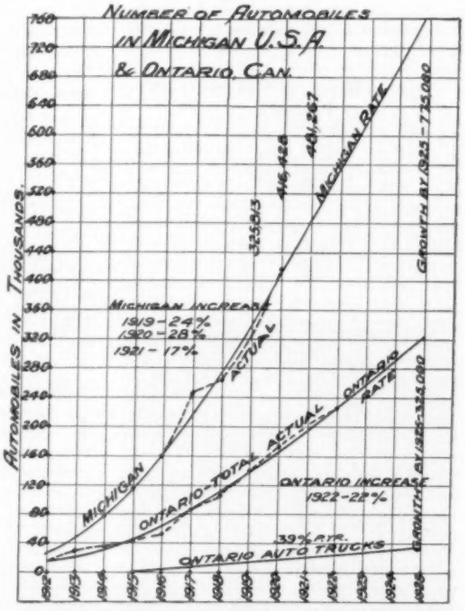
Mr. William F. Parrish of Chicago gives figures obtained in service tests of dilution. After runs of 100 miles, the fuel in the lubricating oil amounted to from 15 to 41 per cent of the total "lubricating" body. Figures for cars and trucks of numerous types, fitted with preheating devices to improve refrigeration, ranged from 14 per cent for 300 miles in three days, to 47 per cent for 563 miles in a month. It is obvious that these cars and trucks were not being lubricated; a mixture of 47 per cent gasoline is not a lubricant, whatever the other 53 per cent may be.

All methods of preventing dilution having fallen down, Mr. Parrish has interested himself in the development of an apparatus that attacks the problem from the other end. If we cannot prevent gasoline from entering the oil, he says, let us cease trying to do so; and let us turn our attention to a means for removing it as fast as it enters. It may well be that, as is so often the case in engineering, this apparently indirect procedure will turn out the most advantageous.

The oil-refining system which Mr. Parrish would add to our automobiles consists of four main units: heating element filter, refiner and cooler. The entire ensemble is simple, light in weight, and takes up about as much space as the vacuum fuel-feed system. It does not interfere with any present system of splash or force-feed lubrication. The vacuum present in the intake manifold is drawn upon for the force to drive the lubricating oil from the crankcase reservoir through the refining system and back again to the reservoir. A tube extends from the manifold to the top of the refiner; through it the suction is delivered to the system, and through it the vaporized fuel which has been removed from the oil is returned to the intake manifold at such temperatures that it becomes part and parcel of the intake charge.

The system, aside from this feature, is largely self-explanatory in the light of our photograph. Heat is taken, of course, from the exhaust. The heater, while in operation, is either filled with oil to the exclusion of air, or is working with oil passing through it under force of the vacuum. In this way charring of the oil is avoided. Heaters have been opened after several thousand miles and found free from carbon deposits. This, of course, is essential; we may as well dilute our oil with gasoline as burn it up. The filter unit is of such design as to gather in the form of sludge all metal, carbon, dirt, etc., which may be in the oil; and means is provided for cleaning out this sludge as necessary. In this way, aside from eliminating dilution, the device keeps the crankcase oil clean to a hitherto unrealized degree, and thereby greatly prolongs the life of the oil.

In tests with this device, raw gasoline and kerosene were deliberately introduced into the oil in measured pints. This amount of gasoline is eliminated from the crank-case in 30 miles of running, and of kerosene in 60 miles. The sludge removed from the bottom of the reclaimer tank generally contains a characteristic sediment of 75 per cent oil, 12 per cent carbon, and 13 per cent of an ash composed of road dust and metal. A 2000-mile test was run off, throughout which the crankcase oil showed dilution of less than 1 per cent. While there will doubtless be minor difficulties in the way of installation and workout, this system appears to offer a positive solution of the worst phase of the heavy fuel problem. Mr. Parrish recently presented it before the Society of Automotive Engineers, where it had a very favorable reception.



Growth in the home state of the automobile in 10 years from 25,000 to 550,000

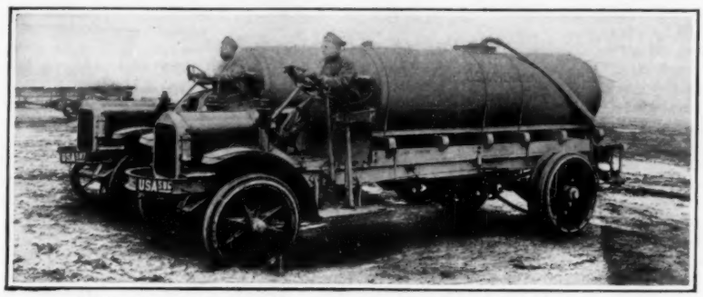
The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Water via Truck

THE performances of the Army during the war held many a lesson for peace-time application, and few of these were more forceful than those to be drawn from observation of all the uses which the military made of automobiles and trucks. We are accustomed, for instance, to seeing gas and oil freighted about the country in tank trucks; but who would have suggested that there was a field for this sort of thing with water? Yet our photograph shows water being trucked in this fashion to a Kansas encampment, long after the cessation of hostilities; and throughout the less-watered regions of the great west there is wide scope for such trucking.



Delivering water to a Kansas encampment in big tank trucks

Four-Wheel-Drive Trucks in Rail Service

BACK in 1917, when railroads first began to experiment with gasoline equipment for light freight and passenger service, the North Western Pacific Railroad was reconstructing a 1400-foot tunnel at San Rafael, California. In reconstructing this tunnel, they found that a steam locomotive filled it with smoke and stifling gases and made it impossible for the construction crew to see or breathe. "Necessity was the mother of invention" in this case and so the engineers of this railroad began to look around for a locomotive of another type. After much research work, the four-wheel-drive truck, which has its power applied to all four wheels, was brought to their attention for consideration.

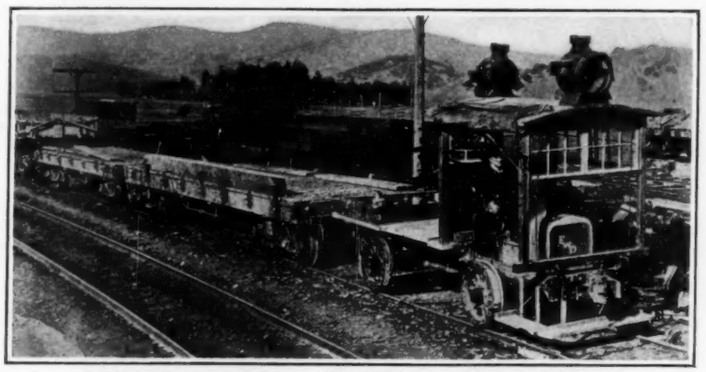
Among other advantages of this truck which made them believe that it could be converted to a suitable locomotive was the fact that the tread on both the front and rear wheels of this truck is 56 inches, which is the same as the distance between the rails on standard gage railroads. Thus, in converting this truck it was not required to shorten either of the axles. Flanged rims of the proper size were ordered and put on the truck in place of the solid rubber tires which had formerly been used on it. Standard couplers were mounted on the front and rear of the truck and a locomotive type cab was placed over the driver's seat. When the truck was finally completed and tried out, it was found to be so satisfactory that after work on the tunnel had been finished it was used for light switching and is still in the service of the North Western Pacific Railroad.

This, perhaps, was one of the first attempts to motorize railroad equipment.

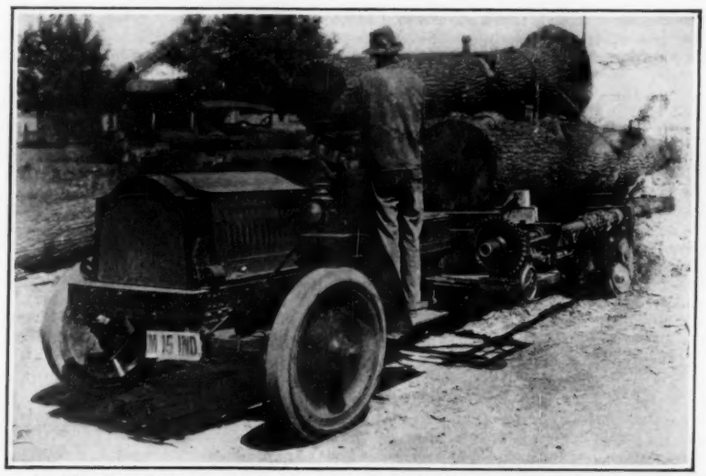
Since this car was put into service, the four-wheel-drive truck, due to its special adaptability to railroad service, has become so popular that at the present time there are over 70 rail cars either in service or under construction. Among the advantages claimed for these rail units are the application of power to all four wheels, giving greater friction and allowing less loss of power through slippage and making it unnecessary to operate the car with a pony truck. The differential in each of the axles takes care of the difference in speeds of the inside and outside wheels when the car is rounding a curve. The rail car on one interurban line is obliged to round a curve which has a 45-foot radius. This is sharper than is found on any short line railroad.

Chassis Repairs

EVEN after the power plant and gearset have received attention, there are numerous points about the chassis of the truck that should be inspected if a thorough overhauling is called for. The chassis of any well-built machine will need but very little attention, if the various parts are well oiled, until it has been used from ten to fifteen thousand miles. After this distance has been covered, the driver will probably be annoyed by a series of squeaks and rattles, even though the engine and gearset are in perfect running condition. These rattling noises indicate wear at a number of relatively unimportant bearing points, and even though the depreciation is slight, the looseness at the multiplicity of small points will produce a noise that will be unmistakable whenever the truck is operated on other than perfectly smooth highways. Among some of the things to be looked for are wear in the various control linkage members, sagging or bent frame side members, loose cross members or gusset plates, due to rivets having loosened up in service; stiff action of the springs, due to rust accumulating between the leaves; looseness in the steering gear and steering connections, lack of alinement of the front and rear wheels, looseness of the wheel hub bearings, and numerous other conditions of similar nature—all of which contribute to the ability of the truck to produce superfluous noises.



One of the earliest attempts to substitute the truck for the locomotive—and one that still lives



Showing that even in the big woods the truck is not out of place

It is not unusual to find the rivets at the corners of the frame or those holding cross members and gussets or reinforcing plates loose. If they are not very loose, satisfactory repairs can often be made by peening them over again, using a heavy hammer and a suitable dolly bar or rivet set to receive the force of the hammer blow. A rivet set for framework may be easily made by taking a large bar of square or round section iron or steel, three feet long and two inches in diameter, and turning up one end at right angles to the bar about three or four inches back from the end. Both ends are then tapered down so that the area is approximately an inch square. A suitable countersunk depression is then made to receive the rivet head at each end of the bar; one may also be placed on the side of the bar about an inch from the end. This will permit the use of the same bar in corners as well as on rivets so placed that the length of the bar does not prevent its being held against the rivet heads. Two men are required to do a good job of riveting, one to manipulate the riveting hammer, the other to hold the dolly bar up against the rivet and absorb the impact of the hammer.

In the event the frame members are very loose it indicates that the rivets have become reduced in diameter and partially sheared. In cases of this kind nothing will be gained by peening the rivet heads over more. The only safe remedy is to chip off the rivet heads with a sharp cold chisel and then knock them out of the holes with a steel drift. The holes are then drilled to the next larger standard rivet size and new rivets secured. These are usually of Norway iron, and should be heated to a red heat in a gas or coal forge before being headed up.

The frame side members sometimes sag after the car has been used for a period, especially if it is operated at high speeds over rough roads, or in the case of a motor truck that has been made to carry overloads. A weak channel section member of this character can be made stronger by either of two methods. It may be reinforced by a plate riveted to the interior or it may be trussed by truss bar and turnbuckle arrangement. Sometimes a plate is added to both inside and outside of the frame and the whole held together by a series of rivets or bolts.

Taking the Horse Truck Out of the Woods

NOTHING is more characteristic of logging as it was done from 1800 to 1900 than the sight of a huge truck, piled high with logs, and hauled through the muck and over the corduroy of the woods trails by four, six, or even more husky horses. If there is one place in the world where a truck might be expected to fail, it is here. But with the right kind of equipment it seems just as easy to get the logs out by gas as by horse; and there need be no argument over the proposition that, if it can be done at all by gas, it can be done more cheaply so.

The Heavens in January, 1923

How the Astronomer's Work Carries Him from Star to Electron, and Back Again

By Professor Henry Norris Russell, Ph.D.

FROM the earliest days when men watched the heavens they must have noticed that the stars differed, not only in brightness, but in color. Some are white—with even a bluish tinge, others yellowish, others yellow and orange, and a few red. There is no better time to see this for one's self than on a clear winter evening. Looking toward the south our eyes will first be impressed by the brilliant Sirius, whose light is pure white. As we turn our gaze upward we find Orion. Here the three stars of the belt are whiter even than Sirius—a blue-white, indeed, though the difference is not conspicuous to the unaided eye, which is a poor judge of color except in the brightest stars.

Betelguese, close by, affords a glaring contrast, and its ruddy glow cannot escape the most casual glance. Far above, in the zenith, we find Capella, which is yellow—about half way between the two extremes of color already noticed. Procyon, on the left and lower, is a good example of a yellowish-white star, and Pollux, in Gemini, affords light of an orange hue.

It is now quite certain that these differences in color are due to differences in the temperature of the stars' surfaces—that of the red ones, like Betelguese, being about 3000 degrees Centigrade, of yellow ones like Capella some 6000 degrees, and of white stars from 10,000 degrees to 15,000 degrees or more. Also it has long been known that these differences in color go with notable differences in the spectrum.

Colors and Spectral Lines

A red star, of what is called Class M at Harvard, shows a spectrum crowded with dark lines, due to absorption by vapors within its atmosphere, and revealing the presence of many of the familiar metals, as well as of the compound, titanium oxide. In the orange and yellow stars the bands due to the latter disappear—evidently because the compound is decomposed into its elements at the higher temperatures—but the lines of the metals persist. When we reach the yellowish-white and white stars—like Procyon or Sirius—we find the metallic lines growing fewer and weaker, and only those remain which, in the laboratory, are produced but in the electric spark, and not in the cooler arc-light. Finally, when we come to the very hot stars in Orion, the lines of the metals almost disappear, while those of helium, oxygen, nitrogen and carbon come into sight—for the first time in the series, except for oxygen, which shows a few faint lines in the yellow stars like the sun. Hydrogen alone is ubiquitous, showing its lines in all the stars, though most strongly in those like Sirius.

Some of these differences are easy to understand; others have long been puzzling. Are there really no metallic vapors in the atmospheres of the hot stars? If they are there, why do they not absorb the familiar lines, and reveal themselves in the spectroscope? If they are not there, what has become of them? On the other hand, are there no helium or nitrogen in the cooler stars?

We cannot get out of the difficulty merely by supposing that some stars are composed of metals, and others of hydrogen, helium and other gases; for in such a case we should expect to find both hot and cool stars of each composition, and therefore red stars with no metallic lines and blue-white ones with no helium lines. No: it is clear that the temperature of the star itself must be the main factor in the differences, so that, if we could heat up a red star, the metallic lines in the spectrum would fade out and the lines of helium and nitrogen appear. What happens, then? Are the atoms of the metals decomposed into helium and other gases by the high temperature? This was once a very attractive idea, and some people still advocate it. But recent work in the laboratory shows that there is no chance at all of breaking atoms up into other elements by such mild means as a temperature of twenty or thirty thousand degrees. Rutherford, to be sure, has smashed atoms by hitting them with the alpha particles emitted from radium; but to abuse the atoms as violently by merely heating the gas, we should have to go to a temperature of hundreds of millions of degrees.

The Problem of Star Composition

In the star's atmosphere the sodium and iron and calcium and helium must be there all the time, with no change of one element into another. This looks worse than ever; but the solution is now in sight. Though it takes a tremendous disturbance to disintegrate the tiny, close-knit nucleus of an atom, it is relatively an easy matter to knock off one of the electrons on the outside, which are held by smaller forces. This does not change the atom into one of another element, but leaves it with a positive electric charge—which is called ionizing it. All atoms except those of hydrogen can lose more than one electron, but it is harder and harder to get succeeding ones away. Now only the atoms which have all their electrons can absorb the familiar spectral lines of the element. When one electron is gone, the ionized atom absorbs quite a new set of lines—those characteristic of the element in the spark (where the atoms are again ionized). When two electrons are removed, we doubtless get still another set of lines; but there is good reason to believe that these are mostly in the far ultra-violet part of the spectrum. This we cannot observe in the stars, because light of this sort cannot get through the miles of air above our heads.

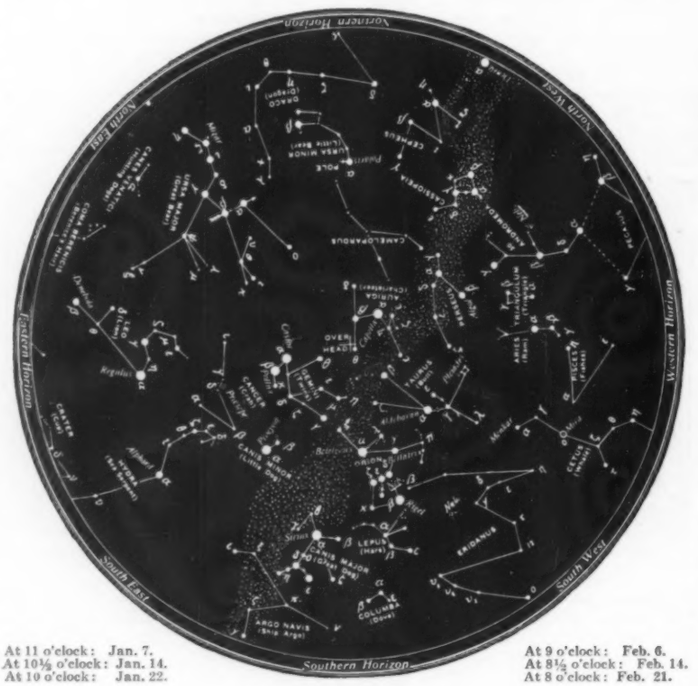
It is much easier to ionize an atom of most of the metals than one of hydrogen; and nitrogen, oxygen and helium are still harder to ionize.

With the aid of this information, gained, bit by bit, in the laboratory, we can understand what happens in the stars. As we pass from the cooler to the hotter stars, we find the easily ionized atoms of the metals losing an electron. At first this happens to only a small percentage of them, but later to practically all. Hence the ordinary lines of the metals grow weak and vanish, while the spark lines appear and strengthen. At still higher temperatures the ionized atoms lose a second electron, and pass into a state where they absorb practically no lines at all in the visible spectrum. Therefore these atoms disappear from our spectroscopic investigation, not because they are not there, but because their spectroscopic properties have altered. Meanwhile, nitrogen and helium, which are so hard to excite that, at low temperatures, they absorb no visible lines at all, get stirred up, and their lines appear.

We can thus see how the conspicuous differences in the spectra of the stars can be explained, without having to assume that there is any chemical difference at all in the composition of the stars, or that some elements are transmuted into others.

The Heavens

The winter sky is so familiar that we need do little more than look at our map. Orion is high in the south with Taurus above and Canis Major below. Canis Minor and Gemini are on the east and Auriga overhead. Leo and Hydra are in the east, Ursa Major in the northeast, Ursa Minor and Draco in the north. Cassiopeia and Cepheus occupy the northwest. Perseus, Andromeda, Pegasus and Aries are in the west, with Cetus and Eridanus in the southwest.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.
At 9½ o'clock: Jan. 29.
At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

NIGHT SKY: JANUARY AND FEBRUARY

The Planets

Mercury is an evening star at the beginning of the year, and reaches elongation on the 12th, 19 degrees from the sun. At this time he sets at 6:30 P. M. and is easy to see. He then draws rapidly in between the earth and the sun, and passes through conjunction on the 29th.

Venus is a morning star, and very conspicuous, rising at 3:50 A. M. in the middle of the month. Mars is still an evening star, setting about 10 P. M. all through the month. Jupiter is a morning star in Libra, and rises about 2 A. M. Saturn is some 25 degrees further west, and is in quadrature with the sun on the 10th, when he is due south at 6 A. M. Uranus is an evening star in Pisces, too near the sun to be well seen, while Neptune is in Leo, and observable in the morning hours.

The moon is full at 10 P. M. on the 2nd, in her last quarter at 8 P. M. on the 9th, new at 10 P. M. on the 16th, and in her last quarter at 11 P. M. on the 24th. She is nearest the earth on the 8th, and furthest away on the 23rd.

During the month she passes near Neptune on the 5th, Saturn on the 9th, Jupiter on the 11th, Venus on the 13th, Mercury on the 18th, Uranus on the 20th, and Mars on the 22nd.

The conjunction with Venus will be interesting, for the moon passes right in front of the planet and occults it. As seen from Washington the planet disappears behind the bright limb of the moon at 6:20 A. M., and comes out again from behind the dark side at 7:18. These times will differ from place to place, but not greatly in the eastern States.

The opportunity to see an occulation of a planet is rare, and it will be well worth getting up to see. On the 27th the moon again occults the bright star Aldebaran, hiding it (from Washington) between 5:27 and 6:30 P. M. This, too, will be worth looking for.

The Eclipse Expeditions

WHILE it is still far too early to look for any definite announcements of results, something can now be said about the general success of the numerous parties that went into the Pacific Ocean in September. The Christmas Island expedition was a great disappointment. Prepared for over a ten months' period with extreme care, this expedition met bad weather continuously, and nothing could be done either in the way of eclipse observations or in the way of comparison of northern and southern stellar magnitude scales—the work which had been planned to keep the party busy while awaiting the eclipse. The conditions, however, appear to have been ideal throughout Australia, and enthusiastic statements have come from the six continental expeditions. It appears that, by good fortune, Evershed, who had intended to photograph the eclipse from the Maldives, changed his plans and went to Worral. At this place were the Lick Observatory party under Campbell, and that from Toronto under Chant.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

NAVIGATING INSTRUMENT.—B. W. PRALL, 160 College Ave., West New Brighton, S. I., N. Y. The principal object of the invention is to provide an instrument which may be utilized to discover the direction in which an aviator must fly in order to proceed on a straight line to his destination, and will also indicate roughly the ground speed which will be made, provided weather conditions remain the same. Another object is to provide a navigating instrument with which wind velocity and direction may be determined while in the air.

DIRIGIBLE.—C. J. LYNDE, Ste. Anne De Belleville, Quebec, Canada. The invention has for its object the construction of a dirigible in which, primarily, the axis of resistance, of the envelope and gondola, and the line of pull of the propellers are in the same straight line at all speeds, and in which the resistance force produced by the combination of the pull of the envelope and the downward pull of the gondola is equal and opposite to the pull of the propellers at all speeds, and in which most of the movements on the part of the envelope will not be imparted to the occupants of the gondola.

Pertaining to Apparel

REVERSIBLE GARMENT.—C. F. ZITTING, Idaho Falls, Idaho. The invention has for its object to provide a garment which may be worn with either side outward, wherein the garment has a collar and cuffs of two thicknesses of material of contrasting colors, the corresponding colors being on the same side of the garment, and wherein the garment is provided with closing flaps, one flap having buttonholes and the other buttons secured to a flexible cord arranged within the edge of the flap and swingable in either direction.

GARMENT.—L. GARWITT, 160 Fifth Ave., New York, N. Y. This invention relates more particularly to knitted garments which are liable to stretch at the shoulders. The invention is particularly intended for use in connection with such articles as sweaters, although not necessarily limited to this adaptation, the construction being such that the stretching tendency of the shoulders will be reduced to a minimum.

NECKTIE FORMER AND FASTENER.—W. F. OLSON, 403 North 40th St., Omaha, Neb. The object of this invention is to provide holding means to be engaged by lateral members of the tie to aid in simulating a tie including a neckband portion. The device comprises a top bar having clamps at the ends to engage under the lower edge of the neckband of a collar, said bar having downward bends flaring outwardly relative to each other.

NECKTIE.—M. SPIEGLER, 430 South Main St., Los Angeles, Calif. The invention relates to what are generally known as four-in-hand ties. The object is to prevent such ties becoming wrinkled, by providing a permanent knot and at the same time to preserve the advantages in appearance of the hand knotted tie, by means of a collar encircling portion and a detachable coupling for the same.

BATHING COSTUME.—P. TOBOREK and F. ZAMBRINI, Nice, France. This costume is characterized by the fact that it has, around the chest, a double thickness, forming air pockets closed at the top and open at the bottom, for use as an aid in learning to swim, the air for ensuring buoyancy is driven back and compressed in the upper part of the pockets by the water entering at the bottom, this water flowing away in a natural manner, when the bather comes out of the water.

Chemical Processes

CONDENSATION PRODUCT OF PHENOL AND FORMALDEHYDE AND METHOD OF MAKING SAME.—W. ACHTMEYER, 29 Silver St., Middletown, Conn. The invention relates to the production of a condensation product of phenol and formaldehyde, which will be thinly liquid and non-inflammable, and which will be convertible into a product having a high temperature of carbonization, so that it is suitable for impregnating objects which are exposed to high temperature in actual service.

PHENOLIC CONDENSATION PRODUCT AND METHOD OF MAKING SAME.—W. ACHTMEYER, 29 Silver St., Middletown, Conn. This process consists in causing a reaction between phenol and methylenediphenyl-diamine and removing the water formed by the reaction, adding 7 to 10 per cent of a methylene compound to the product and heating the mixture.

WATERPROOFING AND GASPROOFING COMPOSITION.—J. D. SEE, 124 Avenue des Champs Elysees, Paris, France. The invention has for its object an adhesive composition having special qualities of flexibility and impermeableness and applicable more especially to rendering fabrics waterproof, for forming envelopes of balloons, and aeroplanes, or for use as an adhesive for many other purposes. The composition is produced from acetate of cellulose and caoutchouc, which are dissolved in tetrachlorethane. The composition can also include sulfur, an accelerator of vulcanization, and can be vulcanized.

ALLOY.—F. MILLIKEN, 110 William St., New York, N. Y. This invention has for its object to provide an alloy capable of being rolled, drawn, forged or worked in other ways while being cold to form rods, wires, tubing and the like. The alloy contains the following materials in substantially the following proportions: copper, 60-70 per cent; nickel, 9-12 per cent; zinc, 19-24 per cent; iron, 1-2½ per cent, and a trace of manganese.

Electrical Devices

ELECTRIC-LAMP LOCK.—H. E. WILLIAMS, 811 S. Main St., Carthage, Mo. The invention relates generally to electric-lamp locks, and more particularly to a means whereby to prevent unwarranted removal of an electric lamp from its socket, the object being the provision of simple means, whereby the features which bring about the desired end may be applied with equal facility to the socket or the base of the lamp which is screwed into the socket.

ELECTRICAL OUTLET BOX.—S. L. SOPENOFF and M. KATCHER, 318 Broadway, New York, N. Y. The object of this invention is to provide an electrical outlet or junction box which is simple and durable in construction, and arranged to firmly clamp the conduits in position in the box. Another object is to provide a single member for clamping several conduits in place and support the several knock-out disks.

RHEOSTAT.—E. C. FASOLDT, address Louis R. Krug, c/o Burdick & Son, Albany, N. Y. An object of the invention is to provide a rheostat capable of micrometer adjustment. A further object is to provide a rheostat capable of such delicate adjustment that the same may be used as a potentiometer, and a rheostat which provides for a micro-ampere flow of current, such as is used in a vacuum tube for the reception of a telegraph, wireless or radio receiving outfit.

ELECTRIC FORGING AND HEAT-TREATING FURNACE.—F. G. DAWSON, 5740 Woodrow Ave., Detroit, Mich. The invention relates to an electric forging and heat-treating furnace, and has for its object the provision of a simple and efficient furnace structure wherein the electrodes cooperate to produce the desired amount of heat without establishment of a free burning arc, whereby the need for complicated automatic controllers is eliminated. A further object is the arrangement of the electrodes in such manner that the charge is uniformly and quickly heated.

ELECTRICAL FURNACE FOR TREATING ORES.—A. COUNAS, 133 Boulevard Saint Michel, Paris, France. One of the objects of this invention is to enable the complete treatment of the ores to be carried out in one furnace, without it being necessary to subject them to a preliminary roasting and enables both the temperature of the furnace and the position of the zone of maximum temperature to be regulated so as to render the fusion of the metals possible, while only permitting of the volatilization thereof when that is advantageous to the operation.

ELECTROMAGNETIC POWER ANVIL BLOCK FOR RIVETING.—P. G. SIGOND, address Mrs. Margaret Sigond, c/o J. B. Jonjon Roche, 312 Union League Bldg., Los Angeles, Calif. The primary object of the invention is to provide means which, while manipulated to a certain extent by an operator, possesses certain features which enable the same to be self-operated at least to an extent that it will not require unusual difficulty in using the same. A further object is to produce a device which will enable the work to be carried out much faster and at a greater saving than has heretofore been possible.

Of Interest to Farmers

WAGON BODY CONSTRUCTION.—W. KOUNS, Salina, Kans. Among the objects of the invention is to provide a running gear whereby two horses may be disposed along the sides of the wagon, leaving the front and rear of the wagon adapted to use in connection with any farm implement or device such as a hay rake, and to provide means whereby one person can operate the team and the wagon efficiently, when provided with farm devices, such as load carriers, at both front and rear.

THRASHER.—J. M. LUNZ, Wright, Kans. An important object of the invention is to provide a grain separator for thrashing machines having means whereby the same will thoroughly separate the grain from the chaff and tailings so that the necessity of returning the grain to the cylindrical beater and concave is dispensed with. A further object is to provide a thrashing machine having means whereby the blast of air through the separator may be regulated to operate under a variety of conditions.

HEN'S NEST.—F. N. BACKLIND, Detroit, Minnesota. The invention relates to a device for saving eggs, and is adapted to be used with any form of nest, or with a simple box. An object is to provide a net forming a flexible hammock-like nest whereby eggs are immediately upon being laid, trapped into a compartment separate from the nest proper so as to prevent the hen from eating or breaking the eggs, or a brooding hen from sitting upon them. The nest egg will not roll into the receiver as it is placed under the net.

Of General Interest

FIELD GLASS.—E. K. DUNNE, 41 Cedar St., Oneonta, N. Y. The invention has for its object to provide a construction wherein maximum size lenses may be used in a comparatively small holder. Another object is to provide means whereby the parts may be moved toward or from each other to secure the right distance to accommodate readily the eyes of any person, and to provide lids or ends glasses which will automatically close when the glasses are collapsed and open as the glasses are extended for use.

SAUCER.—D. F. LOUDON, 109 W. 102d St., New York, N. Y. The invention relates to a saucer intended for use in connection with tubs, pots, etc., which are adapted to receive plants. An object is to provide a saucer which may properly support a plant-holding receptacle, in such a manner that all surplus water may be drained off, thus preventing the tub bottom rotting, and without the necessity of elevating the receptacle from the saucer.

SMOKING PIPE.—G. A. MILKIE, 99 State St., Brooklyn, N. Y. An object of the invention is to provide a pipe in which the smoke is passed through a cleansing liquid so that the smoke is cooled and purified before reaching the mouth of the smoker. A further object is to provide a pipe having a water reservoir associated therewith, which will be compact, and neat in appearance, yet not heavy enough to inconvenience the smoker.

CAN HOLDER.—B. K. GEROJOHN, Box 119, R. I., Wharton, N. J. An object of the invention is to provide a holder for shoe polish cans or boxes, which will prevent evaporation of the polish and which will eliminate the inconvenience and delay oftentimes caused by the cover of the shoe polish can sticking or getting out of shape and retarding the opening of the can.

CLOTHESLINE BRACKET AND TRAY.—D. E. DAVISON, 515 Leonard St., Brooklyn, N. Y. The invention relates to an apparatus for supporting a clothesline in such a manner that one end may be moved into a room through a window when applying or removing clothes and may be moved to a position exterior of the window when not in immediate use. The device is of strong construction and easily operated.

CAMERA.—V. A. GIANETT, 353 W. 37th St., New York, N. Y. The invention particularly relates to a simple inexpensive moving picture camera, and has for one of its objects to present a construction which will secure so-called moving pictures either on a sensitized film or sensitized strip of paper. A further object is to provide a camera adapted to produce strips of small pictures in short time and at small expense.

MOLD FOR TYPOGRAPHICAL SLUGS.—L. C. TINSLEY, Sterling, Kans. Among the objects is to provide a slug comprising a plurality of sections fragilely connected, the fragile portions adapted to be broken away to receive the rules when the slugs are set up in the galley. A further object is to provide a slug which can be cast in any ordinary typographical machine employing the ordinary matrices, adding little, if any, to the cost of production.

UNIT SLAB FOR BUILDING WALLS.—B. F. DAVIS, c/o Mechanics Hotel, 38 N. W. 8th St., Miami, Fla. This invention relates particularly to a unit slab capable of being molded apart from the wall in which it is to be utilized, as, for instance, at the factory or molding sheds from which it may be sent to the point of erection, the object being to provide a simple inexpensive slab, through the use of which the joining of slabs in a wall and finishing the interior by means of plaster may be readily completed.

PENCIL.—H. A. CLARK, Box 1257, Detroit, Mich. A purpose of the invention is the provision of a pencil of extremely simple, light and durable construction so formed as to accommodate sticks of lead which are adjustable to provide points at the opposite ends of the pencil, and which are capable of being locked in any adjusted position.

TRUNK.—A. W. BALDER, Rehresa, Calif. The invention has for its object to provide a trunk adapted for use as a trunk or as a dressing table or case, wherein there are legs for supporting the trunk, said legs being hinged to the body to fold up at the corners, and the lid and the legs having interchangable means for detachable connection, and clamping the legs during transportation, the arrangement being such that the legs will reinforce the corners of the trunk.

PENCIL HOLDER.—H. A. CLARK, Box 1257, Detroit, Mich. The purpose of the invention is to provide a pencil holder by means of which short or stub pencils can be almost completely used. The device is formed of a single blank of metal bent to provide a pair of jaws adapted to support in opposite relation two pencils, a spacing tip limiting the inward movement of the pencils.

ANIMAL TRAP.—G. G. ANDERSON, Box 106, Miami, Arizona. Among the objects of the invention is to provide a trap of the above character more particularly adapted for trapping mice, rats or the like, which may be set without danger and which is extremely sensitive to being tripped. The trap is of durable construction and inexpensive to manufacture.

HAIR CURLER.—A. SCHARER, 2580 Broadway, New York, N. Y. One of the primary objects of the invention is to provide a hair curler in which the use of heat is entirely dispensed with. A further object is to provide a curling device in which the hair during curling is subjected to pressure.

The curler is of such construction that it may be worn upon a person's head.

DOWEL PIN.—P. FOTACOS, c/o Zeppas & Co., 231 1st Ave., New York, N. Y. The invention relates more particularly to an anchoring means carried by the pin for positively securing the opposite ends of the pin within the dowel openings of the members to be joined. This anchoring means is automatically shifted into anchoring position by the members to be secured together by the advancement of the same toward each other.

RAT TRAP.—R. CHASSE, deceased, address R. J. Chasse, 101 Henry St., Brooklyn, N. Y. This invention has for its object the provision of a construction which is simple and comparatively inexpensive to manufacture, while at the same time presenting an extremely strong device in which a comparatively large bait may be used without danger of its being removed, and which will properly operate each time it is tripped.

METALLIC KEG.—R. W. BLANTON, c/o Ironton Mfg. Co., Ironton, Ohio. The invention relates to kegs, barrels and similar receptacles for the transportation of solids and heavy articles. The purpose is to provide a metallic key in which the body is comprised of sections so interlocked as to prevent relative movement and to permit of interchanging of the sections for the purpose of substituting a new section for a damaged one. The head sections cooperate with interlocking means for the body sections in reinforcing the body against collapsing.

ASH SIFTER.—P. MISCHKE, 10 Bueling Spring Ave., Rutherford, N. J. The invention has for its object to provide a construction which may be placed on an ordinary ash can, the parts being so arranged that practically no dust escapes during the sifting operation. A further object is to provide an ash sifter in which the ashes may be readily separated from the cinders and directed to a given discharge point, while the cinders are directed to a different discharge point. (See Fig. 1.)

WINDOW SCREEN MOUNTING.—G. W. GETSINGER, 228 W. State St., Savannah, Ga. The object of the invention is to provide a screen mounting for screens of the telescope or folding type, whereby a screen will be continuously held for fully closing the window opening in which the screen may be associated. It is also an object that the mounting means permit the screen to be easily lowered or raised.

SHOE STRETCHER.—H. WATERS, Box 182, Bisbee, Arizona. Among the objects of this invention is to provide a shoe stretcher having means whereby either the forward or rear end of the stretcher body may be readily spread for stretching either the toe or intermediate portion of a shoe, and means whereby the shoe may be stretched longitudinally.

HAIR COMB.—C. STRIER, 1295 Ocean Parkway, Brooklyn, N. Y. This invention was primarily designed for use with bobbed hair. An object is to provide means for holding the hair in position and preventing the same from falling about the face. The device comprises a curved comb for retaining the hair in position at the back, and barrettes attached to the comb for gripping the hair at the sides.

CARBOY CARRIER.—A. J. BECKER, Box 275, Caldwell, N. J. An object of the invention is to provide a device with which carboys may be handled without danger to those engaged in the handling. A further object is to provide a carboy carrier which will positively grip the carboy and obviate accidents. The device is simple, practical, strong and comparatively inexpensive to manufacture.

GARMENT HANGER.—H. L. BIENER, 298 Utica Ave., Brooklyn, N. Y. The object is to provide a garment hanger arranged to prevent garments, particularly delicate silk waists and the like, from becoming soiled by rust spots incident to contact of the garment with the metal hook or rubber-covered hook now generally used. Another object is to provide a celluloid covering for the suspension means, which is not liable to crack or capable of injuring the garment.

ICE CREAM STORAGE APPARATUS.—C. A. KULENKAMPFF, 123 White St., New York, N. Y. The invention has for an object to provide a construction of storage units which will permit the ready circulation of the cooling medium without interfering with the insertion or removal of the filled ice-cream container. Another object is to provide an apparatus in which a double-walled container is presented with an arrangement whereby the parts may be readily separated for repair or renewal.

WINDOW.—D. A. MACASKILL, c/o A. ZELLINGMAN, 210 19th St., Brooklyn, N. Y. The invention relates to a window in which sliding sashes are arranged to have swinging movement inwardly for the convenient washing of the window or for ventilation. The general object is to provide means whereby to permit of the convenient assembling of the various parts entering into the window and the convenient removal of the sashes, frame parts, balancing means, etc., as may be required for repair or otherwise.

CASSEROLE FRAME.—J. J. O'MARA, c/o O'Mara Specialty Co., 145 Roebling St., Brooklyn, N. Y. The invention has for its object the construction of a frame and handle portions for casseroles so designed that the assembling of the parts is such as to permit and facilitate the polishing of the main frame before the handle portion is attached. A further object resides in the provision of a handle and frame portion so cooperating as to permit of their ready assembly.

HAIRPIN.—A. WENGER, 432 Broadway, Bayonne, N. J. The invention contemplates a pin constructed to provide a multiplicity of hair receiving spaces having restricted entrance openings which when engaged with the hair will be held in place against accidental displacement, and is so constructed as to prevent pulling of the hair upon removal of the pin or otherwise injuring the scalp.

CUE TIP FASTENER.—H. J. GREIER, c/o Mrs. Jacobs, 141 Grassmere Ave., Fairfield, Conn. This invention has for its general object to provide a fastening means for cue tips that will secure the tip against strains exerted at all sides as well as to provide a clamping of the fastener means into position with the application of the tip of the cue.

PENCIL HOLDER.—A. D. PERALTA, 13 Ave. Norte H. Q. Guatemala, Guatemala, C. A. An object of the invention is to provide means whereby all the lead in an ordinary lead pencil may be used up. The principal object is to obviate the waste of lead by providing a pencil holder into which an ordinary pencil may be adjustably fitted. A further object is to provide such a device which will be durable, neat in appearance and comparatively inexpensive to manufacture. (See Fig. 2.)

CEILING.—M. WIEPCKE, 130 Coffen St., Brooklyn, N. Y. The invention relates to the method of forming a ceiling, and has for its object to produce a construction which may be readily placed in position in such a manner that certain parts of the ceiling will be connected with the floor members and will form a substantially sound-proof structure. Another object is to provide a ceiling formed with reinforcing members and retaining members coacting therewith to act as a means for spacing the ceiling from adjacent structures.

OPTICAL PROJECTION APPARATUS APPLICABLE PARTICULARLY TO OPTICAL PROJECTION LANTERNS, CINEMATOGRAPH PROJECTORS AND THE LIKE.—P. E. CORRELL, Kimo Flats, Phillip St., Sydney, New South Wales, Australia. Among the objects of the invention is to provide an apparatus particularly adapted for the efficient projection of brilliant pictures from slides or "films" of paper or other opaque and comparatively inexpensive material, upon which the pictures to be projected may be printed photographically, or by means of ink. A further object is to permit the use of light of much less candle-power than is commonly employed, thus reducing the cost by using electric bulbs and reflectors.

SEPARABLE FASTENER.—E. R. NEBELING, 472 Fulton St., Brooklyn, N. Y. The primary object of the invention is to provide a clasp for bracelets, necklaces or other jewelry, formed of pearls or similar beaded structures. A further object is to provide a separable fastener in which the two parts thereof are positively locked against accidental displacement, the locking elements moving in a direction at substantially right angles to the direction of strain.

FISHING REEL.—H. E. RAWSON, care Richardson Rod and Reel Company, 536 Lake Shore Drive, Chicago, Ill. An object of the invention is to provide a fishing reel in which means for operating the spool can be moved at will into and out of operative engagement with the spool. A further object is to provide a device having means for normally maintaining the spool-operating means in adjusted position, whereby a positive action on the part of the operator is required to occasion the engagement or disengagement.

SAFETY BOTTLE.—F. CLARK, Durango, Mexico. The general object of the invention is to provide a bottle formed of glass, clay or other suitable material adapted for holding liquids and other commodities, and available as an original container, by reason of the necessity of breaking part of the bottle in order to afford access to the contents, so that any attempt to subsequently use the bottle may be detected.

SOAP SAVING SHAVING MUG.—J. A. MATTHEWS, Quapaw, Okla. The invention relates to a shaving mug which facilitates the maintenance of the mug in a sanitary condition and is productive of economy in the use of soap. Among the objects is to provide a mug adapted to hold certain standard brands of soap permanently in the center of the bottom whereby all of the soap may be used without breaking.

HAND STAMP.—S. A. RAUCH, 334 Greenwich St., New York, N. Y. An object of the invention is to provide a rubber stamping device, comprising a thin backing plate, and a handle pivoted thereto, and adapted, when not in use, to lie flat against the surface of the backing plate, whereby the stamp will occupy small space for shipment, or for slipping into a vest pocket.

BLASTING SHELL OR SHEET.—R. L. BOWMAN, R. F. D. No. 5, Knoxville, Tenn. The object is to provide a blasting sheet or shell for use in coal mines, rock quarries or other places, which is available to the miner as a ready and complete shell, which has a variable capacity whereby it may be adapted to various sized holes and which is so constructed that a considerable length of the shell occupies but a small space, and may be carried without discomfort.

ANTISKID DEVICE FOR SHOES.—G. L. SWENY, 431 South Wayne St., Piqua, Ohio. Among the objects of the invention is to provide an attachment which can be readily applied to or removed from a shoe, and which when in applied position, will engage the surface traversed in such manner as to prevent the slipping of the wearer upon a wet or slippery surface. The device may be applied to shoes of various sizes without injury to the shoe.

DEMOUNTABLE ARTICLE OF FURNITURE WITH MULTIPLE COMBINATIONS.—E. G. LECONTE, 146 Rue Lafayette, Paris, France. The object of this invention is to provide an article of furniture composed of flat pieces, such as shelves, and uprights or columns, with screw-threaded rods, which can be readily assembled and demounted and which allows of making numerous articles of furniture. The operations of mounting and demounting consist of inserting the ends of the uprights in suitable holes in the shelves and in screwing the uprights or columns to each other.

SEMI-AUTOMATIC FILLING DEVICE FOR TOY BALLOONS.—O. S. KING, 218 East 42d St., New York, N. Y. An object of the invention is to provide a device for filling toy balloons by which the labor entailed on the part of the operator is reduced to a minimum, and thereby a much larger number of balloons can be filled in a given time.

URINAL TRAP GUARD AND DISINFECTING DEVICE.—G. A. SLEIGHT, Hyde Park, N. Y. The invention relates to a guard and disinfecting device and has for an object to provide a construction wherein a proper amount and a proper quality of disinfectant may be placed and used as needed without washing. Another object is to provide an arrangement of pan for preventing the liquid from washing undesirably the disinfectant used in connection therewith.

Hardware and Tools

THREAD-CUTTING TOOL AND HOLDER THEREFOR.—D. BRECKENRIDGE, Victoria, B. C., Canada. The object of the invention is to provide a form of cutting tool and holder therefor by means of which the cutting of screw threads of V or square form is effected with accuracy and dispatch. A further object is to provide a holder which adjustably supports the cutting tool so that threads of various pitch can be formed with the same tool, without removing the tool from the holder. (See Fig. 3.)

CUTTING DEVICE AND RECEPTACLE THEREFOR.—S. OBERLANDER, 2743 Broadway, New York, N. Y. An object of the invention is to provide a container or receptacle for a safety razor blade by means of which the same may be safely housed, permitting of its being carried without danger of the blade injuring the user, and by means of which the operator may be enabled to manipulate the blade for various purposes, such as the opening of seams, cutting material, etc. (See Fig. 4.)

PIPE-THREADING TOOL.—A. JARMOLOWSKY, c/o Nipple & Pipe Cutting Co., 171 Mercer St., New York, N. Y. An object

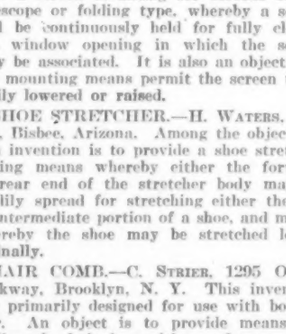


Fig. 1: Self-discharging ash-sifter invented by P. Mischke

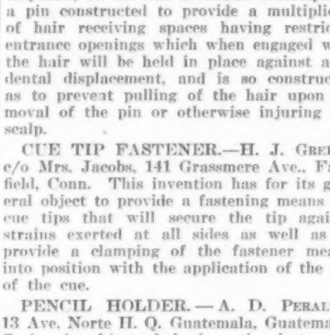


Fig. 2: A. D. Peralta's pencil holder that uses up all the lead

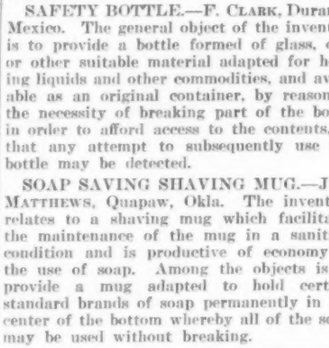


Fig. 3: Machine for better cutting of screw threads, patented by D. Breckenridge

Fig. 4: Wider utility for the safety-razor blade, as obtained by S. Oberlander

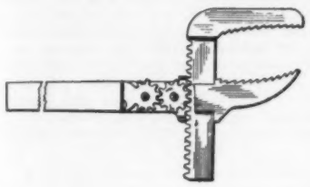


Fig. 5: Self-adjusting wrench of novel design invented by C. A. Short

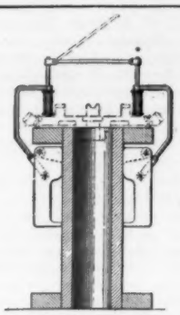


Fig. 6: W. E. Bedell's anvil for supporting ring gears to be riveted to a gear plate

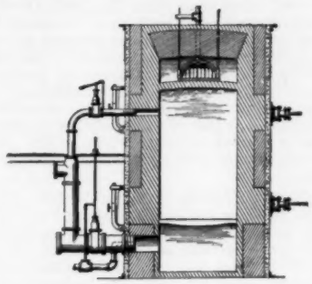


Fig. 7: Apparatus for producing gas from bituminous coal, invented by W. E. Elliott

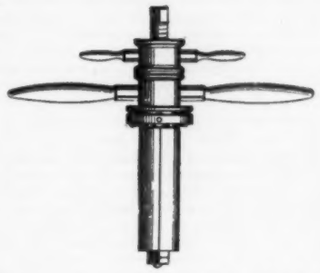


Fig. 8: Machine patented by E. B. Miner for making the bead or flange of the end of a boiler tube

of the invention is to provide a tool for gripping nipples or short portions of pipes whereby they may be easily threaded without placing them in a vise. A further object is to provide a tool adapted for a plurality of uses, which can be quickly and easily operated to grip and release the articles to be worked upon.

DRILL BIT.—J. J. BROSSOIT, 253 Edison St., Salt Lake City, Utah. This invention relates particularly to the cutting surface of drills. An object is to provide means whereby the cutting surface of a drill shank may be readily removed to be sharpened and readily replaced. By this method it is merely necessary to have a number of cutting portions on hand, thus saving time lost in resharpening.

CALIPER.—B. N. DUDUKIAN, 318 E. Lafayette St., Syracuse, N. Y. Among the objects of the invention is to provide a combined micrometer and caliper formed with means which will permit a quick adjustment of the jaws or arms of the caliper and will at all times show the exact distance therebetween to within a thousandth of an inch, or other distances according to the graduations provided.

SASH FASTENER.—J. O'CONNOR, 437 W. 43d St., New York, N. Y. The general object of this invention is to provide a latch of the indicated type for holding the sashes or other relatively movable parts fastened while open to a greater or less degree or in the closed position. More especially the invention has in view the production of a fastener which is simple, of few parts, and may be adjusted with facility, to prevent the possibility of breaking the sash.

SURVEYING INSTRUMENT.—A. D. HADSEL, Iowa Hill, Calif. The primary object of the invention is to provide an instrument for actually plotting various positions of stadia rods on the plane table without the inconvenience of mathematical calculations. According to the invention the result is obtained mechanically regardless of any vertical angle with which it may become necessary to treat.

SHEARS.—E. N. ARNOT, 235 Vincente St., San Francisco, Calif. The invention relates to a tire-repairing tool and has reference more particularly to a tool which includes in combination a cutting device, an abrasive surface, a moistener, and a spreader for applying an adhesive substance. The primary object is to provide a handy device for repairing tires, for instance, in applying patches to inner tubes without necessitating taking the tube to a repair shop.

NUT LOCK.—J. V. WOODWORTH, 1032 Lorimer St., Brooklyn, N. Y. The particular object of the invention is to provide a nut lock that will positively lock the nut on the bolt or screw it is secured to by bending parts of the threads it comes in contact with out of shape, so that it is impossible for the nut to be turned on the screw or nut in either direction.

TOOL.—J. L. DYER and H. T. MACNEIL, Box 145, Balboa, Canal Zone, Panama. This invention relates to a tool which is designed to facilitate the handling of cartridge fuses. An object is to provide a device which will permit the insertion or extraction of cartridge fuses into or from a fuse clip without the slightest danger of injuring the operator. A further object is to obviate the danger of causing short circuits or grounding.

WRENCH.—H. W. WATSON, 1098 Monroe Ave., Memphis, Tenn. The invention particularly relates to that type of wrench in which different sized sockets or spanners are used for various sized nuts. One of the objects is to provide a wrench structure by which nuts may be quickly run up or down on a bolt and then tightly locked in place. Another object is to provide a wrench that is quickly reversible, and one that does away with crank extensions.

CREASING IRON.—F. G. HOFMANN, 1350 Fulton Ave., Bronx, N. Y. This inventor aims to construct a tool which will supplant a number of tools such as are now used in leather and other trades, in that its parts are capable of being adjusted to permit of creases or grooves of different widths being made. A further object is the construction of a device including a heating element which will be capable of bringing the tool to the temperature desired.

VISE.—E. GOODREAU, Cordova, Territory of Alaska. The object of the invention is to associate pneumatic means with a pair of jaws constituting a vise whereby the same may be actuated for gripping an object therebetween in a positive manner, and also be adapted for releasing the object in a quick and expeditious manner. The lever is extremely simple in construction and easy to manipulate.

WRENCH.—C. A. SHORT, Manila, Philippine Islands. An important object of the invention is to provide a self-adjusting wrench having means whereby the jaws are securely engaged with the object to be rotated as the handle is operated. A further object is to provide a wrench having means whereby the jaws are released from gripping engagement with the object when the handle is returned to its operative position. (See Fig. 5.)

SHOVEL.—W. COULSON, care Abe S. Rosenzweig, Spring Valley, Ill. An object of the invention is to provide a shovel by means of which one can lift a greater load than with an ordinary type of shovel. The device comprises a slightly curved handle, the blade being relatively large and having an upwardly curved rear and side portion forming a U-shaped recess.

TOOL.—O. K. BOGSTRAND, Brooklyn, N. Y. The invention relates to tools for the laying or repairing of ship decks, flooring or the like. The tool includes a number of elements or parts capable of association and adjustment, simultaneously forming a screw-receiving opening, including a plurality of bores of various diameters. The device may be employed for removing screws having broken heads, for driving nails or screws further down or for the insertion of a new plug.

ANVIL.—W. E. BEDELL, Montpelier, Idaho. This invention relates to a work-supporting anvil, and has special reference to an anvil for supporting ring gears which are to be riveted to a gear plate. An object is to provide a simple and efficient clamping means whereby the work may be very readily fastened to the supporting plate, and to provide a simple, rugged and easily operated gripping means. (See Fig. 6.)

LOCK.—F. A. MCCABE, Blackfoot, Mont. An important object of the invention is to provide a lock of the permutation type which cannot be operated by any person unacquainted with the combination by the method known as "sense of touch," or any similar method. Another object is to provide a lock in which the locking means or bolts are not thrown by movement of the dial, but by separate and independent means.

CHUCK.—W. L. MCLEAN, 1111 Turk St., San Francisco, Calif. The invention has reference more particularly to such chucks as are used in connection with screw drivers, drills and similar rotating tools. The principal object is to provide this chuck with jaws adapted to adjust themselves to the particular shape of the bit to be engaged, and with auxiliary means in case the means ordinarily provided for this purpose do not allow of the application of sufficient strength to rotate the bit.

MICROMETER.—J. BREWER, 1442 Vyse Ave., Bronx, N. Y. An object of the invention is to provide a precision instrument or micrometer which will directly display the reading in order to enable a mechanic to scale off dimensions from bodies to be measured to obtain the dimension without making intermediate calculations. A further object is to provide a window through which the graduated scale is readable, and an extensible frame to enable the operator to measure either large or small bodies.

Heating and Lighting

STOVEPIPE THIMBLE.—J. M. MEADE, Box 67, Honeoye, N. Y. The invention relates to stovepipe thimbles especially adapted for use between floors and ceilings. The object is to provide a pipe thimble which is so constructed as to be absolutely fireproof and to completely insulate the adjacent structure of the building so that fire will be prevented irrespective of the degree to which the stovepipe may become heated.

HEATER.—A. R. J. DEARDEN, 189 Myrtle Ave., Jersey City, N. J. The general object of this invention is to embody in a heater in the form of a radiator, an arrangement of flues forming a circulation circuit in coaction with the heat-producing means with a view to the effective application, utilization and radiation of the generated heat. A specific object is to simplify and facilitate assemblage, adjustment and repair.

FURNACE PIPE.—H. A. ACER, 611 West Center St., Medina, N. Y. The invention relates more particularly to the heater pipes of hot-air furnaces. The general object is to provide a pipe arranged with double walls to conserve the heat and minimize the radiation from the pipe, the upper portions and lower portions of the walls having air holes therein in vertical alinement.

OVEN.—A. GUSSA, c/o O. B. Shook, Roswell, New Mexico. The primary object of this invention is to provide an oven with a set of movable trays or shelves, the position of which is automatically controlled by the opening of the oven door, which will cause the shelves to move out, thus obviating the necessity of exposing the hands to the intense heat of the interior of the oven while inserting or removing the cooking pans.

GUARD FOR GRATES.—W. S. BOARD, Middleport, Ohio. The invention relates to grates of the type installed in open fireplaces, and more particularly to guards for such grates. An object is to provide a guard which will extend above the plane of the grate and serve to prevent pieces of fuel from falling out, as well as to protect the clothing of persons from the burning fuel. The device can be applied to or detached from a grate without any changes to the latter.

GAS-PRODUCING APPARATUS.—W. E. ELLIOTT, Struthers, Ohio. The purpose of the invention is to provide an apparatus for producing combination water and coal gas, and more particularly for treating bituminous coal to produce the above result. A further purpose is to produce in a single apparatus gas producing, carbureting and heating means to eliminate the separate apparatus generally required for each of these means, this being accomplished in such manner as to greatly enrich the gases and to materially increase the gas-producing capacity of the apparatus. (See Fig. 7.)

GAS HEATER.—H. E. LOEBE, 1700 Boulevard, Jersey City, N. J. The object of this invention is to provide an economical gas heater, with more complete combustion than usual, thus eliminating smells and giving greater efficiency in the heat power for the amount of gas consumed. This object is accomplished by mounting in the mantle above the burner a flame spreader that delays the progress of the gases, and constructing the mantle and flame spreader of a material that retains heat.

VALVE FOR IRONS.—H. I. FRANKEL and H. M. DUSTIN, 518 W. 143rd St., New York, N. Y. The invention relates to mechanism for a gas-heated steam iron, an object being to provide in the base of the iron a steam chamber with steam orifices in the bottom face that the steam may be directed onto the cloth or goods during the ironing to moisten the goods and prevent the necessity of a previous sprinkling, and to provide valve mechanism for controlling the flow of steam.

Machines and Mechanical Devices

TUBE BEADING OR FLANGING MACHINE.—E. B. MINER, 65 E. Holland St., Portland, Ore. The object of the invention is to provide a machine which is adapted to provide the requisite bead or flange at the end of the tube of a boiler, when the same is in position in the boiler, which is of simple and durable construction and reliable in operation, and which enables the beading of the tube to be effectively carried out with a minimum expenditure of time, labor and skill. (See Fig. 8.)

DISPENSING MACHINE.—J. E. KENKEL, 308 Central Ave., Great Falls, Mont. The primary object of the invention is to provide a dispensing machine in which the reservoir and feed box will form one element, and to generally simplify the construction, to the end that a correct operation will at all times be assured in that a jamming of the apparatus is virtually precluded.

METHOD OF MAKING SHOES OR CASINGS FOR PNEUMATIC TIRES.—B. DE MATTIA, Clifton, N. J. The invention has for its object to provide a method of manufacturing shoes by first forming a cylindrical blank provided with beaded edges, which blank is thereafter expanded along its longitudinal medial line between the beaded edges, while the beaded edges are simultaneously caused to approach each other, to secure the desired form in cross-section, after which shaping-mechanism is applied and the shoe is vulcanized.

COTTON MACHINERY.—J. L. HART, c/o Hart Cotton Machine Co., Chickasha, Okla. The object of the invention is to provide a machine which receives the cotton as it comes from the field, being especially adapted for handling roughly picked or bolled cotton, separates the hulls and foreign matter from the cotton, segregates the cotton on the one hand and the hulls on the other, discharges the hulls, and feeds the cleaned cotton to the gin.

DRAFT REGULATOR.—W. W. SMALLEY, 4738 Congress St., Chicago, Ill. An object of this invention is to provide an automatically controlled draft regulator which is adapted to open a draft door and to close the check draft of a furnace. A further object is to provide a device which is simple in construction, and which is not likely to easily get out of order.

METHOD AND TIRE-VULCANIZING APPARATUS.—O. M. FREDD, Hancock, Mich. This invention relates to an apparatus for vulcanizing tires, and it pertains more

particularly to the core or former used within the shoe of the tire during the vulcanizing process. The primary object is to provide a device capable of use with cores or formers, as commonly employed. A further object is to provide means by which the cores may be heated independently of the heating medium of the vulcanizing mold.

GRINDING DEVICE.—C. SHLAGEL, Clara City, Minn. An object of the invention is to provide a grinding device arranged for convenient attachment to a lathe and more especially designed for grinding the interior surface of a worn-out cylinder of an internal combustion engine to make such cylinder again true and smooth for the proper working of the piston. A further object is to permit of grinding a cylinder accurately and in a comparatively short time. (See Fig. 9.)

BOX PRESS STAMP.—J. I. POGUE, R. No. 1, Box 32, Omak, Wash. An important object is to provide a stamping mechanism for fruit box presses having means whereby the desired characters or words may be readily stamped on the box as the cover is pressed on the box and which mechanism does not interfere with the nailing of the cover. A further object is to provide stamping mechanism for fruit boxes having means whereby the printing drum may be readily adjusted. (See Fig. 10.)

MACHINE FOR CUTTING AND FEEDING TIRE-MAKING FABRIC.—B. DE MATTIA, Clifton, N. J. The object of the invention is to provide a machine by means of which a coated strip of canvas, or other woven textile material, may be cut on the bias into short, and such sections united to form strips of predetermined length and advanced through the machine, thus producing strips in which the threads shall run diagonally from side to side, and whereby strips of the required length may be produced, and delivered directly to a machine for building up tire blanks.

INTERMITTENT FEEDING MECHANISM.—M. J. VINIK, 703 15th St., N. W., Washington, D. C. The invention is more especially designed to reduce the strain on the film of a moving picture machine, when changing from one picture to another, so as to permit an increase in the speed of the change without damaging the film in order to make it possible to eliminate all flicker, and to utilize a greater percentage of the arc light, and to make it impossible to detect the change or "travel-ghost" when forced to discard the shutter on account of a weak source of light.

PLACER MACHINE.—W. R. WILCOX, Manhattan, Nevada. The object of the invention is to provide a machine wherein the clots of dirt and of gravel are pulverized, and are subjected to a scrubbing action whereby the gold and other placer products are separated from the gangue or other refuse or earthy matter, thus allowing the placer product to be readily caught in the riffles while permitting the refuse or gangue to pass off.

CLEANER FOR THE CASTING POTS OR POT WELLS OF LINOTYPE AND INTERTYPE MACHINES.—J. M. PEIFFER, 719 W. Walnut St., Bloomington, Ill. The aim of the invention is to provide a rotating cleaner having a head including normally latched spring controlled means in the nature of scraping or cleaning blades which upon release are capable of seeking and maintaining even uniform engagement with the cylindrical inner surface of the casting pot irrespective of whether or not the head is maintained in true axial alinement with the pot.

SAMPLE TAKER.—B. BRAYSHAW, c/o General Tool and Mfg. Co., 383 4th St., Milwaukee, Wis. An object of the invention is to provide a sample taker adapted for use in connection with milking machines for taking, testing or other purposes, a predetermined part of the milk being obtained. A further object is to provide means for diverting into a bottle of any ordinary construction a desired quantity of the milk. The device may be quickly assembled and rapidly cleaned.

COMPRESSOR.—D. C. BAKER, 1900-1912 Park St., Alameda, Calif. The invention relates generally to air and gas pumps, and has reference more particularly to an air compressor for creating a suitable source of compressed air such, for instance, as is used in air brake systems and other capacities where it is necessary to realize upon a store of compressed air source. Further it is proposed to provide a single unit compressor, including a pair of rectilinear single-acting pistons, both driven by an eccentric drive.

WIRE LINE SOCKET.—C. V. AUGENSTEIN, Macksburg, Ohio. An object of the invention is to provide a wire line socket for use with well-drilling machinery or the like, which permits the use of a wire line or rope and obviates the necessity of using a "manila cable," the socket embodying spring means for providing the desired resiliency.

DISK CLUTCH FACING AND PROCESS OF MAKING SAME.—W. ACHTMEYER, 29 Silver St., Middletown, Conn. The invention relates to the manufacture of clutch facings of the disk type, the object being to produce a product which is non-inflammable, unaffected by water, oil or heat, which is practically unbreakable, under service, and which has a smooth and gradually increasing action. The facing comprises two asbestos rings, the fibers of one lying at an angle to the fibers of the other, and compounded into a unitary mass by a phenol condensation product.

CHAIN-MAKING MACHINE.—E. J. LYTER, 307 New St., Lebanon, Pa. The invention relates more particularly to a link forming and welding machine especially applicable to heavy chain, where it is a major consideration that every link be accurately finished in the same size and shape. The primary object is the provision of a machine by which partially formed links may be completed and welded so that all links will correspond in size, shape and appearance, eliminating the inequalities of hand work.

NUMBERING FIXTURE.—J. SEVERSON, Hasbrouck Road, Hamilton Beach, L. I., N. Y. An object of the invention is to provide a numbering fixture which is adapted for use, in connection with engraving machines, as a substitute for the master blocks heretofore utilized for this purpose. A further object is the construction of a numbering fixture by means of which any suitable reference character may be immediately presented and held against movement so that they may be utilized in operating the tracing stylus.

DEVICE FOR WITHDRAWING SAMPLES FROM WELLS.—W. C. KEITH, care Keith Lumber Company, Beaumont, Texas. The purpose of the invention is to provide a device by means of which samples of the earth formations below the drill bit of a drilling apparatus can be obtained without the necessity of removing the bit or drill pipe from the well, the device being forced down into the earth by a pounding action which is self-contained, thus doing away with specially constructed tools.

MACHINE FOR BENDING CASK HOOPS.—J. U. SUCHET, Huits-St. Georges, Côte d'Or, France. Among the objects of the invention is to effect an absolutely rigid binding of the ends of cask hoops by the aid of metallic clamps which are easily and quickly attached, the machine effecting the binding instantaneously and in a safe manner. The machine is simple in operation and easily controlled.

MATERIAL AND ARTICLE HANDLING APPARATUS.—D. W. CAMERON, Antioch, Nebraska. The object of the invention is to provide a machine for efficiently loading material upon a railroad car of the like, which will uniformly distribute the load over the area to be loaded and which is of simple and durable construction and easily operated. In addition the machine may be used for unloading cars, warehouses, granaries, corn cribs, cellars, root houses or any place where grain, vegetables or other bulky material is stored. (See Fig. 11.)

NUT-SLOTTING DEVICE.—F. A. SCHROEDER, 2439 North Central Park Ave., Chicago, Ill. The primary object of the invention is to provide a device for the making of "castle-nuts." An object is to provide a device which will obviate the necessity of the use of a milling machine. A further object is the provision of a device in which a plurality of nuts may be operated on at one stroke, and in which the nuts are automatically turned between successive strokes to permit of a rapid and accurate operation.

FLEXIBLE POWER TRANSMISSION.—B. GARRISON, 175 Chestnut St., Morgantown, W. Va. The invention relates particularly to the transmission of power in a flexible manner, from its source to any desired mechanism, and one in which the driving member may be run at any desired speed and rotation of the driven member effected, either in a reduced or advanced relation as to speed, depending upon the amount of pull required thereof or the load carried thereby.

ELECTROPLATING BARREL AND CATCHER.—E. A. SEVERANCE, P. O. Box 283, Burlington, Vt. The invention has reference more particularly to plating barrels and a catcher therein, an object being the provision of a plating barrel whereby the operation of the plating is reduced to a minimum, and the time required reduced to a minimum. A further object is to provide a catcher whereby the plated articles may be thoroughly drained and removed in bulk from the barrel.

INDICATOR.—O. E. GROSHELL, 1822 Vernon St., Apt. 32, Washington, D. C. One of the foremost objects of the invention is to provide an indicating device having large numerals, corresponding to smaller numerals in a cash register, adding machine or similar device, the arrangement being such that when the amount is rung up, the indicating device will register the same amount in large numerals in a place where it can be seen by everyone. The device may be connected with cash registers without materially altering their construction.

SAWMILL FEED.—G. S. SERGEANT, Greensboro, N. C. The foremost object of the invention is to provide an arrangement in the driving apparatus whereby great flexibility in the application of the feed mechanism to any rackfeed or ropefeed sawmill now in use may be had, regardless of the particular location of the rack or drum shaft. A further object is to provide a self-contained sawmill feed which can be put on or taken off any sawmill husk in present use.

OIL-WELL-CASING CEMENTING SHOE.—E. V. CROWELL, 826 Santa Fe Ave., Los Angeles, Calif. An object of this invention is to provide a cementing shoe for use in connection with an oil- or gas-well casing, by means of which a cementing mixture, as, for example, mud-fluid, can be ejected from the lowermost section or "oil string" to fill the space between the "oil string" and well bore and thus seal the formation seat against the seepage of water.

Medical Devices

SURGICAL INSTRUMENT.—A. B. COUCH, 1100 Lake St., Fort Worth, Texas. This invention relates to an instrument for use in performing the operation of circumcision, and has for its general object to provide an instrument whereby the operation may be performed without injury and essentially without pain and bloodlessly.

Musical Devices

SPEED REGULATING MEANS.—T. FLETCHER, 125 N. Flores St., San Antonio, Texas. An object of the invention is to provide a phonograph wherein a differential rotational speed is imparted to the turntable so that an equal speed of disk travel under the recorder or reproducer is maintained throughout the playing of the record. Another object is to provide means whereby a positive lateral movement for the turntable driving wheel is obtained for the turntable spindle.

Prime Movers and Their Accessories

PISTON.—V. W. PAGE, Melrose Ave., Stamford, Conn. One of the primary objects of the invention is to so construct a piston that it will have expansible sections which serve to force one of the piston rings into contact with the walls of the cylinder when the motor is cold. Another object is to provide resilient means for operating the expansible sections of the piston.

AUXILIARY AIR INTAKE FOR INTERNAL COMBUSTION ENGINES.—J. H. PROFFITT, 1669 8th St., Santa Monica, Calif. The invention relates to an auxiliary air intake which is adapted to be used in association with the engine intake and may be manually controlled from a point adjacent the driver's seat of an automobile, for controlling the effective port area of the auxiliary intake so as to vary at will the additional air supply. The device may be attached to any type of engine without materially changing the intake. (See Fig. 12.)

MEANS FOR PREVENTING DEAD CENTERS IN ENGINES.—J. CALCATERRA and O. J. BERNARDONI, 1106 Southern Blvd., Bronx, N. Y. The invention has for its general object to provide a novel connecting rod and piston assemblage with the parts so formed and so arranged as to make it impossible for the piston and the crank shaft of the engine to be dead centered.

HYDROCARBON BURNER.—D. McB. SYME, care Sheffield & Harvey, 223 Thames St., Newport, R. I. The object of the invention is to provide a hydrocarbon burner arranged to produce a thorough atomizing of crude oil or other hydrocarbon fuel and to insure the formation of an intimate mixture of the atomized fuel and air with a view to produce a practically complete combustion. Another object is to spread the flame in the combustion chamber to insure a uniform heating.

VAPORIZER.—J. R. SCHMIDT, Marion, Kansas. This invention relates to a heater for the intake manifold of internal combus-

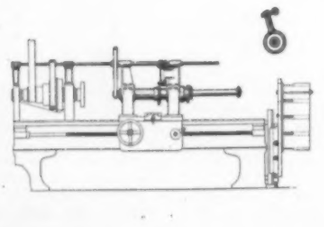


Fig. 9: Cylinder regrinding device for attachment to an ordinary lathe, patented by C. Schlagel

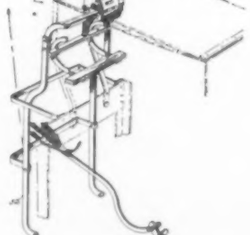


Fig. 10: J. I. Pogue's machine for stamping labels on box-covers while the cover is being nailed on

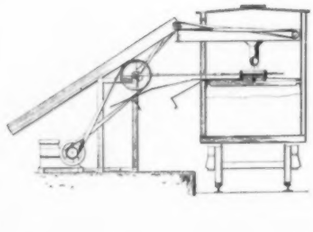


Fig. 11: Railroad-car loading machine invented by D. W. Cameron

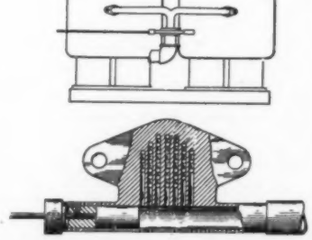


Fig. 12: Auxiliary air-intake for internal combustion engines, the design of J. H. Proffitt

tion engines whereby to apply vaporizing heat to the fuel passing into the motor through the intake manifold, the object being to provide a simple manually controlled and electrically heated arrangement which will be inexpensive and will at the same time be durable and effective in use.

METHOD OF AND MEANS FOR BLOCKING SADDLES FOR STEAM BOILERS.—R. REES, Smedley St., Kapunda, South Australia, Australia. Among the objects of the invention is to provide a pair of dies so shaped that the corners or ends of the base of the saddle and the lower portions of the sides are pressed to finished shape and the base pressed to an angular shape having a raised center, and the bottom die being formed with cross passages through which water is caused to flow to prevent the plate tearing at the corners.

VALVE GRINDER.—F. J. DERIFIELD, Boise, Idaho. The object is to provide a valve grinder especially adapted for grinding valves of the overhead type which embody a valve and cage, in which the valve and its seat are subjected to such grinding action as will insure a uniform grinding of the entire working surfaces of the valve and seat whereby perfect seating is brought about and wherein all the phases of the grinding are automatically carried out.

Railways and Their Accessories

CAR-DUMPING APPARATUS.—W. R. COLEMAN, 1021 S. 19th St., Birmingham, Ala. The invention relates to means particularly designed for dumping tram cars at mines, such means being actuated by a hand lever or the like. Arranged in connection with the track section is a brake that will stop a "trip" of cars, and then automatically release the cars in single succession for movement toward the dump. The dump is arranged to turn through an angle alternately to the right and left to invert the cars sufficiently for discharging their contents.

FREIGHT CAR CONSTRUCTION.—C. PECK, 26 Stockton St., Bloomfield, N. J. An object of the invention is to provide a car which can be readily used for carrying loads in separate units or in packages or in bulk. The car may be used to carry part of its load in bulk and part in separate packages or units. A plurality of doors are provided on the top of the car, which may be quickly opened, and efficiently locked in closed position. In carrying a load in bulk the same may be easily dumped.

CHAIR FOR RAIL JOINTS.—R. FREEMAN, Perrine, Fla. One of the foremost objects of the invention is to provide a chair designed to absolutely prevent sagging and side play. When the lateral thrust of the car wheels is exerted against the rails at the joint, there is, by the construction of this device, a tendency to tighten the joint.

RAILWAY TIE AND FASTENER.—H. A. CLARK, Box 1257, Detroit, Mich. An object of the invention is to provide a railway tie and fastener of durable construction, whereby each element thereof may be replaced when no longer serviceable on account of wear. A further object is to provide a fastener which will effectively support the rails and hold the same in position against spreading, and at the same time be sufficiently elastic to be unaffected by the wave motion in the rails.

AUTOMATIC BALL-BEARING SIDE BEARING FOR RAILROAD TRUCKS.—G. M. HYNDES, 1719 S. Lamar St., Dallas, Texas. An object of the invention resides in the provision of means whereby the friction between the side bearings on trucks and cooperating elements on the car body is reduced to a minimum. Another object is to provide a simple, rolling bearing mounted within a suitable casing which can be readily attached to any type of truck without the need for special apparatus, tools or appliances. (See Fig. 14.)

MACHINE FOR REMOVING RAILS AND EXTRACTING SPIKES.—F. R. MASON and T. FITZPATRICK, Ronan, Mont. The object of the invention is to provide a machine which when drawn along by a tractor such as a locomotive or the like, automatically lifts the rails from the ties and extracts the spikes, which carries out its operation speedily and without distortion of the rails, and which is in general of simple and durable construction and easy to operate.

CAR COUPLING.—R. L. LOWE, 138 Baltimore St., Hanover, Pa. The object of the invention is to provide a simple inexpensive construction which will be strong, durable and efficient in its uses, while at the same time automatic in action. The coupling consists of a pair of superimposed longitudinally alined coupling bars, one of which is laterally swingable; the two major parts may be stamped from single pieces of the required weight and thickness.

Pertaining to Recreation

GAME APPARATUS.—J. HAMPSON, 9 Campden Hill Gardens, London, W. S., England. The invention relates more particularly to apparatus for playing a "race game," in which the horses or other moving figures are drawn along by means of cords wound upon suitable devices adapted to be operated by the players. The playing surface may comprise a table or the like, a ship deck, a lawn, or other suitable surface.

CONSTRUCTIONAL TOY.—J. L. L. ROQUEFORT-VILLENEUVE, 77 Rue du Faubourg St. Jacques, Paris, France. The invention has for its object to provide a constructional toy adapted for building models of various kinds of cycles, motorcycles and similar vehicles. Specially formed portions are provided for forming the forks, steering pillar, handle bars and other characteristic parts of cycles and like vehicles.

EXERCISER.—G. A. LINDSTROM and G. SENN, Green Bay, Wis. This invention has for its object to provide an exerciser which may be connected to the top of an ordinary doorway, without marring the finish of the frame of the doorway, and when so connected will provide a horizontal bar firmly held in place and capable of supporting any reasonable weight that may be put upon it.

TOY AND AMUSEMENT DEVICE.—W. C. HADLEY, 20 Morningside Ave., New York, N. Y. This inventor has been granted two patents having for their objects the production of toys designed to be supported on and actuated by the keys of an automatic or player piano, one of the objects being to utilize the up and down movement of the keys to operate the movable parts of the toys which represent comical or grotesque figures or animals. A further object is to provide a plurality of such devices designed to be used in close relation to each other. A further object is to provide means whereby the tilting movement of the figures will produce a rattling sound simulating the effect produced by castanets.

AMUSEMENT DEVICE.—W. C. HADLEY, 20 Morningside Ave., New York, N. Y. This invention relates more particularly to an amusement device adapted to be supported and operated by a phonograph. The object is to produce a device having a movable member carrying upon its front face representations of various objects, and which by the movement of the member, will cause the objects to be at times concealed from the view of the observer, and at other times brought into view, the movements being imparted by some movable element of the phonograph.

Pertaining to Vehicles

STEERING DEVICE FOR MOTOR VEHICLES.—W. B. Thomas, 336 E. 1st St., Jacksonville, Fla. The object of the invention is to provide a steering device wherein the steering column is collapsible and hollow, and the controlling devices for the motor are also collapsible with the column, and wherein the steering wheel is hinged to the column to swing into a plane transverse to the axis of the shaft, and wherein releasing mechanism is provided for holding the column extended and controlled by the swinging of the steering wheel.

AUTOMOBILE FENDER.—S. G. FITZ SIMONS, 63 Broad St., Charleston, S. C. The inventor aims to provide simple means whereby the fender is opened up by the weight of a person struck, the opening of the fender also being accompanied by a forward movement of the lower curtain-carrying member so that the fender will act as a scoop and thereby pick up the person struck. The device may be applied to a motor vehicle without altering the construction of the same.

BALL AND SOCKET DEVICE.—H. F. WHITTED, 414 W. Main St., Santa Paula, Calif. The object of the invention is to provide a ball and socket device especially adapted to be organized with the gear shifting lever of an automobile transmission or the like, and in which the ball is held firmly in the socket and all vibration or rattle is eliminated, which takes up wear and which is simple and durable in construction and reliable in operation.

TIMER.—E. J. LEE, Bangor, Pa. The invention relates more particularly to timers such as those employed in connection with Ford automobiles, the object being to provide a construction and arrangement of parts, with anti-friction bearings, which will be automatically adjustable to take up wear and will be continually effective with very little if any friction and without the necessity for constant lubrication and replacement of worn parts.

ELASTIC SUSPENSION FOR VEHICLES AND OTHER BODIES IN MOTION.—F. L. BROUSSOUSE and P. J. LEBOUCHER, 19 Rue Theodore de Banville, Paris, France. The invention has for its object to provide a suspension device of great stability, combined with easiness or rolling or gliding. The result as obtained by a combination of springs, arranged in order to obtain a great flexibility in the middle part of the suspension, and a flexibility decreasing in a progressive manner as one is displaced in one direction or the other, away from that middle part.

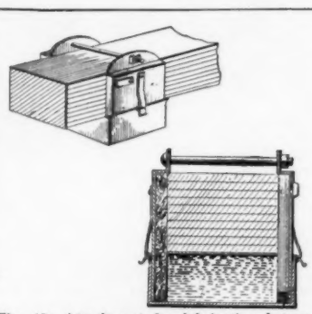


Fig. 13: Attachment for lubricating between the leaves of springs, invented by D. L. Lawson

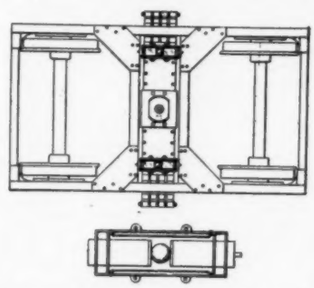


Fig. 14: A different bearing for roller trucks, as developed by G. M. Hyndes

TRAILER HITCH FOR AUTOMOBILES.—I. B. CESSNA, Box 88, Hoisington, Kan. This invention relates generally to automobiles, but more particularly to Ford cars; the object is to provide a simple inexpensive form of hitch which may be readily connected to the differential housing so as to form a more or less permanent part thereof without danger of interference with other parts of the machine.

BICYCLE PROPELLING MEANS.—N. J. GREENISON, 1962 University Ave., New York, N. Y. The invention pertains more particularly to a driving means for bicycles. Among the objects is to provide a bicycle propulsion in which greater leverage may be obtained, thus greatly reducing the effort attendant the driving operation. As the rider exerts pressure upon the foot pedals, levers are rocked about their pivotal points, and through the medium of elongated slots and the cranks, the sprocket wheel is rotated through the medium of a chain.

AUTOMOBILE SIGNAL.—C. E. BLINN and G. W. CHRISTIE, c/o Day & Night Auto Supply Co., Vancouver, Wash. This invention relates more particularly to means for giving information respecting the direction in which the driver intends to turn. The object is to produce a simple, efficient and readily legible device adapted to obviate signaling by the driver's hand. The device may be mounted higher than the driver's head, where it will be visible from the rear.

COMBINATION CIRCUIT CONTROLLER.—H. V. BELL, 30 Hanson Ave., Glendale, L. I., N. Y. Among the objects of the invention is to provide means for variously completing the magneto circuit in an automobile or the like, the purpose being to permit the driver to close the circuit by selectively giving positions to the movable elements and at the same time to present difficulty to one surreptitiously endeavoring to complete the circuit after it has been broken by the driver by a displacement of the circuit-closing elements.

RIM.—G. E. GRUNDIG and S. DIBBINS, 46 Wolcott St., Brooklyn, N. Y. One of the objects of the invention is to provide a rim for tires in which the tire may be more readily removed than is the case with rims commonly employed. A further object is to provide a rim with a removable bead in order that the tire may be slipped on the rim without the necessity of stretching, pulling and the consequent bunching of the inner tube.

TRAFFIC MIRROR.—J. MANDEL, 70 E. 122d St., New York, N. Y. The invention relates to a mirror of special construction which will act in the ordinary capacity of a mirror and which may be manually operated as a signal member. Another object is to provide a mirror with a housing and a spring-retained signal hand which may be operated from an open or closed car.

TIRE-PRESSURE GAGE CONNECTION.—O. H. HANSON, 21 Gerry Ave., Elmhurst, N. Y. An object is to provide a combination gage and safety air chuck for attachment to tire valves, so that a pneumatic tire may be inflated to any predetermined pressure, the safety device warning the operator that the desired pressure has been reached in the tire. The device is simple and inexpensive to manufacture.

TRACTION DEVICE FOR WHEELS.—C. K. HOLT, Box 2688, Honolulu, Territory of Hawaii. The purpose of the invention is to provide a device by means of which sufficient traction is secured to effect the removal of the wheel and vehicle from sandy, muddy or snowy surfaces or depressions in a road. The device is so constructed that it may be readily attached to or detached from an automobile or vehicle wheel.

LUBRICATING SYSTEM.—P. H. GASKINS, 1207 Graham Bldg., Jacksonville, Fla. This inventor has been granted two patents of a similar nature, their object being to provide a lubricating system for vehicles which insures a proper distribution and application of lubricant to the various elements of the vehicle, such as the chassis, spring suspension, spring leaves, steering mechanism, and the other mechanism and elements of the motor vehicle, which utilizes force and instrumentalities readily available and adapted for the purpose in all standard motor vehicles, and which is simple, durable, reliable and easy and inexpensive to manufacture and apply.

LUBRICATING ATTACHMENT FOR SPRINGS.—D. L. LAWSON, Orby, Calif. The invention has for its object to provide a lubricating device for supplying oil between the leaves of an elliptic or semi-elliptic vehicle spring in a uniform manner, whereby undue pressure and friction between the springs may be located. It is also an important object that the lubricating attachment be adapted to closely regulate the amount of oil to be supplied, and at no time to supply an excessive quantity of oil. (See Fig. 13.)

Designs

DESIGN FOR A GLOVE GAUNTLET.—J. RICE, c/o Wimelbacher & Rice, Broadway and 17th St., New York, N. Y. This inventor has been granted patents of four ornamental designs as above stated.

DESIGN FOR A DOLL.—E. B. CARD, 143 E. 39th St., New York, N. Y.

DESIGN FOR A DIRECTION INDICATOR FOR VEHICLES.—T. C. ANTHONY, Gordon, Pa.

DESIGN FOR A LIGHTING FIXTURE ARM.—H. W. GROSSMAN, c/o Colonial Chandelier Works, 122 Centre St., New York, N. Y.

DESIGN FOR A CHILD'S COSTUME. MARGARET A. YORK, 123 East 57th St., New York, N. Y.

DESIGN FOR HANDKERCHIEF, NAPKIN OR SIMILAR ARTICLE OF MANUFACTURE.—J. HARDEN, c/o Acheson Harden Co., 66 Leonard St., New York, N. Y. The inventor has been granted patents for four ornamental designs for the borders of handkerchiefs or similar articles.

DESIGN FOR LACE.—B. SHAPIRO, Lynne Ave., Seagate, N. Y.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Reconstruction of the Brooklyn Bridge

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial article in the October SCIENTIFIC AMERICAN, "The Truth About the Brooklyn Bridge," is very misleading and *is on a par with the article published by you in your issue of May 31, 1919.* At that time one of the New York dailies employed an eminent engineer to report to it on the statements then made in your paper, and he found the statements made by you had no foundation in fact.

The Brooklyn Bridge should be reconstructed, but in my judgment it would be most unwise to provide for rapid transit trains on the reconstructed bridge. Mayor Hylan's rapid transit plans provide for the removal of all rapid transit trains from this structure and to be carried in the "Dover Street Tunnel." With this arrangement the Brooklyn Bridge will very properly be only used for surface car, vehicular and pedestrian traffic.

The Mayor's rapid transit plan also provides for a new tri-borough bridge, connecting the Boroughs of Manhattan, Bronx and Queens. This bridge will provide for vehicular and pedestrian traffic in addition to rapid transit trains, and will relieve the heavy vehicular traffic on the Queensboro Bridge.

You state that the Commissioner of Plant and Structures has proposed that a new bridge be built between the Manhattan and Williamsburg Bridges. In that you are not correct. The bridge proposed by me will be *between the Queensboro Bridge and the Williamsburg Bridge.* The necessity of a new bridge at this location is apparent to everybody who has knowledge of vehicular traffic over the East River bridges. This would not appeal to one who is unfamiliar with this subject or who does not believe in progress. The conclusions in your editorial were erroneous, as it was never intended that the new bridge proposed by me over the East River was to replace or be a substitute for the Brooklyn Bridge. A review of the *great increase in volume and weight of traffic would make obvious the inadequacy of suggestions made twenty years ago,* and are based on pure conjecture.

Very truly yours,
GROVER A. WHALEN,
Commissioner.

City of New York, Department of Plant and Structures.

[The editorial above referred to, addressed to the Mayor, drew attention to the neglect of the Brooklyn Bridge, as evidenced by the worn and rusted pins at the panel points of the bridge. Commissioner Whalen states that an "eminent engineer" reported that our criticisms "had no foundation in fact." Evidently, the Department of Plant and Structures did not agree with him; for immediately after our criticism appeared we noticed that the bridge painters went over the bridge and painted out the tell-tale streaks of rust around the pins and down the posts beneath them, and we noticed, further, that immediately after that, the Department began to replace worn pins that were visible from each side of the passenger walk. This spurt of activity did not last long and the work was only partially completed. For a year or more, the balance of the worn pins and their streaks of rust have been neglected and today are visible to any passerby.

Although the Commissioner agrees that the Brooklyn Bridge should be reconstructed, he evidently has no intention of carrying out this reconstruction according to the plans made some twenty years ago, and now lying pigeonholed in the files of his Department. He considers that the Brooklyn Bridge should be used only for surface car, vehicular, and passenger traffic. The proposed reconstruction above referred to provides three times the vehicular capacity that is now provided on the bridge, and in addition to this makes provision for four tracks which can be used either for rapid transit or surface cars.

We accept the Commissioner's correction as to the site of his proposed new $40,000,000 bridge, but we still claim that if new construction is to be done it should take the form of first getting the utmost capacity out of the towers and cables of the existing Brooklyn Bridge. When that has been done it will be time to consider the building of an entirely new bridge. We still believe that a new structure would be more effective in meeting the needs of the future if it were above rather than below 59th Street.

If the Commissioner has plans for the reconstruction of the Brooklyn Bridge, other than those filed in his office, the public would be greatly interested to learn something of the character of this reconstruction and whether it will give the greatly enlarged capacity for which the plans of twenty years ago provide.—EDITOR.]

Alternative Plan for Mississippi River Control

To the Editor of the SCIENTIFIC AMERICAN:

By virtue of iteration the engineers in the employ of the government under the Mississippi River Commission seem to have persuaded a great many people and some engineers that the building and rebuilding of levees and continually increasing their dimensions is the only way of escape from the annual flooding of the alluvial valley of the stream. Outlets, cut-offs, reservoirs, are breathed upon with an all-embracing malediction, and the reader is given to understand that there is no choice between completing the levee system to the "provisional grade" (and a few feet more), and returning to the original situation, of a river spreading from bluff to bluff and rolling from Cairo to the Balize three or four months of the year—with this difference, owing to the reprehensible actions of the folks in Illiny, Missoura, etc., of clearing and cultivating their lands and draining their marshes, that there is a lot more water to take care of, and a deeper inundation to be feared, than could occur when 1,200,000 second feet was considered high water.

So far as outlets are concerned, it would seem to be almost self-demonstrative that the more you increase the number of outlets, the quicker the flow of the waters above, with a consequent deepening of the channel and depression of the flood crest. If by some miracle the mouth of the Mississippi could be moved up to the point where Red River enters the Mississippi and the Atchafalaya leaves it, it is obvious that the bottom of the river would quickly be washed out by at least the difference between the elevation at the present time and the mean gulf level; *i. e.*, it would be that much lower, and the bottom of stream for a great, but indeterminable distance would be likewise lowered in a diminishing degree.

At it is, some four hundred thousand second-feet find their way to the gulf through this channel at flood times, and much more would go that way, if the government engineers had not put a check on the volume of this outflow by laying mattresses in the Atchafalaya which prevent the deepening of the channel and the increase of its discharge. If this had not been done, and the Gulf end of the stream had been improved by dredging and straightening the channel, we could easily run 1,000,000 second feet out that way, the distance to the Gulf being about 200 miles shorter than via the mouth of the Mississippi.

The same is true of cut-offs. The river can be shortened easily 250 miles by cutting off the big bends, with an increase in slope equivalent to elevating the head or lowering the foot of the stream by one-fourth, or 1000 inches, or 83 feet. The increase of velocity would inevitably deepen the river.

I beg to call attention to the project which I put forth in 1918, for a ship and drainage canal from Hickman, Ky., to Bayou Sara, La., a mile wide, 30 feet deep, with a capacity equal to about a fourth of the flood discharge of the river and a hydro-electric power of between 750,000 and 1,000,000 horsepower, whose certain effect would be to reduce, by the amount of its capacity, the water flowing in the river channel to a sufficient extent to make the existing levees more than ample to prevent crevasses, and would certainly greatly diminish the extent to which the open basins of the St. Francis, White, Arkansas and Red Rivers on the west and the Obion, Forked Deer, Yazoo, etc., basins on the east are annually flooded.

Yes, there are other ways of managing the river than levees, and all three of those suggested have the merit of requiring little or no further outlay, once the project has been completed.

Memphis, Tenn. T. W. BROWN.

We Hear from Mr. Black

To the Editor of the SCIENTIFIC AMERICAN:

The advance proof which you were good enough to send me of your article "A Square Deal for the Psychics" has had my careful attention, and I appreciate your courtesy in giving me opportunity to reply so promptly to those of the criticisms to which I have adequate reply.

In the Besinnet matter, of course, adequate reply I have none. I am sincerely sorry for the position in which I have placed you. It is a clear case of guilty, without extenuating circumstances. I will tell you how it happened.

When I wrote the ectoplasm article I did so at considerable length. It would have occupied at least two and one-half of your pages. Looking it over, I considered it too long for your paper, especially as I remembered your editorial note (page 367, June) about keeping stories down to the essentials. I accordingly cut out certain parts entirely, and rewrote others. The Besinnet affair as originally written gave McKenzie's seance details, followed by my analysis and conclusions, given, I assure you, in the manner which you outline as the proper way of doing this. Where you now read "electric torch" appeared "psychic light." I boiled about three columns down to two paragraphs, completed the article and sent it along.

It was in this boiling down that I fell. I did not see what I had done; I did not even realize it when I gave the reply to Mr. Roche's letter which you so properly condemn as not meeting the issue. I know that this was sheer stupidity—but I did it. As for claiming that the absence of quotation marks lets me down—nothing doing. I simply made a frightful break. Please do not imagine that I tell you how it happened as a sort of excuse. What I want to do is to clear away any last lingering doubt that I did the thing deliberately. I did not, and am glad to see in your article, and again in your letter accompanying the proof, that you are ready to acquit me on this score. I should rather be considered seventeen kinds of blamed fool than one sort of crook.

Passing to other points, I should like to register a mild protest against one point in your article—the only place, I think, where you yourself have said anything at all to which I am inclined to take exception. I refer to your editorial box, the first paragraph of which appears to give the impression that I have been asked to defend Carriere, Neilsen and Home misrepresentations and have failed to do this. This is hardly the situation.

[*Mr. Black is correct here. Drs. Prince, Doyle and Gradenwitz, respectively, called our attention to points in Mr. Black's accounts of Home, Carriere and Neilsen which did not agree with published reports by those present at seances. These letters came later than the one from Mr. Roche on the Besinnet matter, and to show them to Mr. Black would have meant a further delay in publication of a month. We exercised our editorial judgment in the matter, and decided that Mr. Black was guilty as charged; but not so grossly guilty as in the Besinnet case. Later in our text we quoted what Doyle says in the Carriere matter; we had no space to quote the other two cases in detail. Mr. Black in his present letter goes with some details into all three cases. What he says, while constituting strong argument that these mediums were or are frauds, still fails, in our opinion, to clear Mr. Black of the allegations that he has got certain facts wrong or has presented his own conclusions in the place of facts as he did in the Besinnet case. Our editorial box on page 388 of the December issue, does, however, give the impression that he has been asked for a defense and has had none; and for this slip of our own typewriter we express our regrets to Mr. Black.*—THE EDITOR.]

In connection with Dr. Prince's criticisms of my spelling of proper names, I want to indicate just what difficulties confront one here. I have applied to mediums for information, and, being recognized as a skeptic, have got none—d'Albe's report confirms this. It is of little use to apply to organizations devoted to psychical research, for most of these want to make sure they are giving information to one of the faith—McKenzie's College is a flagrant example, and Dr. Prince's own society has been guilty. In these circumstances, you will see that one must fall back upon writers on psychic matters for the proper names. All the names I used [*we think Mr. Black must have forgotten that he misspelled Besinnet and McKenzie*] were in a form used by psychic writers, and it is impossible to tell which is right unless you trot up to the owner of the name and ask him how he spells it. Among French and German writers I find eleven ways of giving the Baron's name—the variation being from Herr von Schrenk to Dr. Baron von Schrenck-Notzing—you can choose your pick. [*Dr. Prince remarks in this connection that of course if you are going to form a collection of previous misspellings committed by other uninformed writers, you will make a larger collection than if you confine yourself to your own slips; and that one can hardly excuse one's own ignorance by pleading that one has been quoting from an ignorant source.*—THE EDITOR.] I am quite recently informed that the correct style and title is Dr. A. Freiherr von Schrenck von Notzing. And I am sorry I cannot write Einar Neilsen in place of my Einer Neilson—for I learn that Ejner Neilsen is how it should go. [*In this event Mr. Black misspelled it originally; but Dr. Gradenwitz, who has sat with Neilsen, calls attention to the error and spells the name as Dr. Prince spells it.*—THE EDITOR.] And Geley, Richet and a host of other writers agree with me in Franck Kluski. You see it is not all fun getting things right. But it pleases me to know that my "Palladino" is satisfactory to Dr. Prince. Carrington in a recently published book writes both Palladino and Paladino. What do you think of that? If Carrington doesn't know how to spell Eusapia's name [*he was on the committee that investigated her extensively*] of what value is the psychic writer as authority? In passing, I mention that my original, too-extensive manuscript shows "Daniel Dunglas Home," but I might have written Douglas or Hume, or any of the changes that can be rung on this combination, and been in good company. [*It will perhaps interest our lay readers to know that in any event, however it be spelled, the name is pronounced "Hume."*—THE EDITOR.]

Not necessarily because it has direct bearing on any specific criticism that has been made of me, but merely to spread it before your readers in its general connection with the case, I point out the pains to which von Screneck-Notzing went to hide the fact that his Eva C was the Marthe Beraud of Algiers, when he showed her to his

(*Continued on page 57*)

We Hear from Mr. Black

(*Continued from page 56*)

fellow scientists in Munich. This action caused a riot of indignation, as did the fact that one observer who called attention to palpable fraud was debarred from further sittings.

Montreal. JAMES BLACK.

[*The above material is abstracted from Mr. Black's letter, which is too long for complete publication.*—THE EDITOR.]

Conan Doyle Assists Our Psychic Competition

To the Editor of the SCIENTIFIC AMERICAN:

I had no idea of issuing a challenge to you. My complaint was that so many of our bitter critics, such as this Mr. Black, are quite ignorant of the subject which they treat. I am, however, delighted that you should take it up, and would do my best to assist you.

There are, however, some points to bear in mind, and I hope that you will not think me officious if I mention them. I speak from an experience of 36 years and from a very wide reading and converse with experienced confreres.

1. You have already done a very dangerous thing. A large money reward will stir up every rascal in the country, while the best type of medium is unworldly and would not be attracted by such a consideration. For the sake of the cause and their own reputations they would help you if you got the personal support and endorsement of leaders of the movement. If not they would avoid you, for "tests" are often deliberate traps. We are at present disentangling a so-called "exposure" of Hope, the photographic medium, where we find that the responsibility for deception rests undoubtedly with the experimenters and not with the medium. Such cases, and they are not rare, make honest mediums cautious. But if spiritualist leaders are with you they will give all they can.

2. If the money offered as a prize could be spent in sending your representative to the various towns of America and also to London, Glasgow and Paris, it would be far more useful. In fact you cannot give your report until you have done this. You must have the same width of experience which we have.

3. *Everything* depends upon your man, or men. The laws are still obscure, but roughly it is a case of tuning a receiving instrument to a transmitter. Harmony of vibrations is essential for good results—human sympathy, kindness, courtesy, *not necessarily mental agreement.* I went to Eva with an open, expectant mind, but with sympathy for her, and I had ectoplasm in my hand before I left. Miss Scatcherd had a similar experience. Four professors of the Sorbonne sit 'round her like four terriers 'round a rat, and they get nothing. In the same way I may go to a clairvoyant and get a most evidential message, and I may be followed by a policeman in disguise, who will get such gibberish that the court will laugh at a palpable fraud. Thus it works.

4. But it is not merely sympathy; it is deeper in some cases. I know at least one very famous spiritualist whose presence stops all psychic phenomena. He is convinced, as one well may be, on other people's results. His case is really not uncommon. It seems to be the positive, aggressive type that has this inhibition, and this is just the type that so often becomes the researcher. Therefore, if you want truth, as I am sure you do, you must have a gentle, quiet, courteous, sympathetic man for your representative.

5. However honest and sympathetic, he is liable to fall into errors if he has not some honest spiritualist to whom he can refer his doubts and from whom he can receive explanations. There are many such. To exemplify what I mean: I took a clever journalist, with no experience of psychic matters, to a direct-voice sitting with Mrs. Roberts Johnson, a famous medium. When the direct voice began he recognized in it the tones of the medium's voice, and began to make a row which not only spoiled the seance, but got into the press and was considered to be a set-back to spiritualism. This man was Mr. Tilson Young. Now the whole difficulty arose from his own ignorance, and any experienced spiritualist would have told him that the direct voice is *often* in its first stage very like that of the medium, but that if you await developments you will soon find it change, and after a while you may get several simultaneously, and the subject will be beyond the medium's knowledge. I can only suppose that the ectoplasm derived from the medium partakes of the medium's characteristics until such time as the outside forces get more complete control. Anyhow that is the fact, and a hurtful scandal was caused by the ignorance of the sitter and his folly in not waiting and asking explanations.

6. Which leads me to the next point, that the investigator should read a few sound books on the subject: Crookes' researches, Crawford's "Psychic Structures," Schrenck-Notzing's "Materializations," and a general view of the subject such as Charles Tweedale's "Human Survival." He should not be a professed conjurer or psychic observer, but rather a good level-headed man of affairs, with plenty of tact and patience.

7. If such a man came here I would do my best to show him what I could, but he would do best as a visitor introduced by me, rather than as an accredited researcher, the very thought of which makes a medium nervous and abnormal.

I wish you well, but have no delusions as to "final" results. The London Dialectical Society in 1869 were some 80 strong, all impartial men. Their committee's report on physical phenomena was unanimously in favor—and that was 50 years ago. The same occurred with the Paris Committee of Impartials in the 90's, of which Bergson was a member. The mass of prejudice is less than it was, but it is still great and nothing will be final unless we get presently, as I think we may, a new line of evidence.

The problem could, it seems to me, be solved merely on the basis of the wax molds taken by Professor Richet and Dr. Geley from the hands of a materialized spirit, which could only get out of their brittle paraffin molds by dematerializing, since the wrist openings are far too small. I have inspected these hands at Paris. They are quite final in themselves to any open mind. But I admit that these phenomena are quite distinct (and inferior) to the religious side of the question. I enclose a picture of one, from the *Revue Metaphysique* of January, 1922.

I am impelled to reiterate that this unfortunate money offer acts badly in two ways. It not only attracts the worst and repels the best, but it makes it impossible that the investigator should be really, absolutely unbiassed; for so long as in the back of his mind he says, "Well, if I admit this it will cost my employer thousands," he cannot be judicial. But I think that if the SCIENTIFIC AMERICAN could really master and proclaim the facts it would be a great thing for America and for the world.

A. CONAN DOYLE.

Windlesham, Crowborough, Sussex.

[*Most of Sir Arthur's points with regard to the proper conduct of an investigation like ours are so well met by the article of pages 6-7 that a suspicious person might be pardoned for not believing that the article was in type before we received the letter. Sir Arthur's final paragraph, however, calls for specific comment. The statement was originally written into Mr. Bird's text that the five Judges were donating their services to the investigation, out of their interest in its subject. This statement was eliminated, on the ground that it was nobody's business save the Judges'. Sir Arthur, however, makes it rather clear that it is everybody's business. We therefore point out that the conditions conducing to the state of the Judges' minds pictured by him do not exist.*—THE EDITOR.]

The cast, in paraffin, of a hand materialized before Richet and Geley. It will be seen that a normal, anatomical hand could not have been withdrawn from the mold

The Human Element

To the Editor of the SCIENTIFIC AMERICAN:

On your editorial page some time since appeared a paragraph in which you say that you have been criticised for the absence of the "human element" from your pages. I have never noticed that lack; perhaps chiefly because I read several technical journals quite regularly beside your own, which journals are so distinctly lacking in human interest that your journal has appeared very colorful by their side. I do, however, thoroughly agree with your critic in viewpoint, and am glad to see a little progress toward greater human interest in your journal of late. No journal can be said to lose dignity by adding human interest to its pages, so long as it does not sacrifice accuracy and reliability thereby. The feeling that an article must be dry as dust to be scientifically reliable springs in great measure from the Prussian efficiency viewpoint which has unfortunately invaded our own life and institutions to a certain extent.

The difference between the two types of journal is exactly that between two broad types of teachers—the teacher who is primarily interested in research, regards teaching as more or less of a bug-bear to be tolerated for the sake of earning a living, and who is continually lecturing far over the heads of his students, resenting questions as evidences of stupidity; and the teacher who keeps in personal touch with his students, makes them his friends, fills his lectures with homely illustrations from everyday life, bits of humor, sketches of incidents from the lives of scientific discoverers, who encourages questions and answers them simply and plainly—in a word, who is a *teacher*, not a mere research automaton.

I have studied under both types, and have known nothing more discouraging than the first, nor more encouraging than the latter. In fact my interests in after life have been largely molded by the kind of teachers I had. There are isolated branches of science which I occasionally use, to which I can only refer with a strong distaste, despite my strong love of scientific knowledge in general, and those subjects are the ones in which I was taught by teachers who had no business to be teaching. And I owe a strong love of most knowledge to having studied under a line of teachers who loved teaching for its own sake far more than they loved knowledge; and who threw real color into their work and commanded interest in it.

What the teacher is to school life, the scientific journal is to after life. It will be successful in proportion as it can demand the interest of its readers. Even the best of us never quite outgrow the stage when we like to have our food, whether physical or mental, well flavored to make it tasteful. And though most of us do take much unflavored mental food, we will still admit if we are honest with ourselves, that we take the food with the flavoring first and most often, and we get the most benefit from it.

It is regrettable that a certain class of pseudo-scientific journals have sprung up and are thriving upon that demand for human interest, though they have sacrificed accuracy of statement to human interest. The only way in which their work can be undone is by going them one better and furnishing both accuracy and the human element.

The idea that these two qualities are incompatible with each other is utterly false and without foundation. It is interesting to note that the two men whom I regard as the most appealing *teachers* of the thirty or forty-odd I have studied under are both internationally known research men and authorities in their lines (Gale, physics, and Slaught, mathematics, both of Chicago.)

After all this is but a phase of the old problem of education which comes up for discussion periodically, but is never settled. We are still divided into the two opposite camps—the advocates of broad, and the advocates of specialized education. The trouble with the latter is that it does not educate. It merely crams. Man needs knowledge for his work in life, yes; but even more than that he needs the development of those faculties which make the use of knowledge possible. The faculties of imagination, common sense, initiative, originality and even humor are necessary before one can use to the best advantage even the greatest fund of specialized knowledge. And these qualities cannot be developed through grinding over dry facts.

A disinterested financier recently made a public address in which he held the engineering profession up to scathing rebuke because it has furnished so few men who evince qualities of broad leadership. The bitterest part of it was the realization on the part of many of us that he spoke the truth; and that that leadership with the qualities that it entails have been systematically squelched out of us by the Prussianized system of specialized education to which we have been subjected. And if we look at the few real leaders among engineers today, the originators and creators, we find in greater part men who had a broad education in addition to their technical one, or who had a broad education without technical training, or who had no formal education at all. There are more of the two last-named classes in engineering than one might suppose, but not nearly as many as there is room for.

I have departed somewhat from my original theme. I will only say by all means add as much of the human element as you can to the matter in your journal. You are doing more good than you know of.

Downer's Grove, Ill. LEO G. HALL.

San Francisco's Water Supply

To the Editor of the SCIENTIFIC AMERICAN:

Your article on San Francisco's Hetch Hetchy Water and Power Project was very complete except that I think under the caption entitled "San Francisco's Water Supply Project," on page 18 I would suggest that you omit the word "Yosemite" and put in the words "High Sierras" in its place.

May I state in explanation of this that there is confusion in the public mind, especially the Eastern mind, as to San Francisco's water status? Merced River, about 20 miles south of the Tuolumne, drains the Yosemite Valley proper. None of our works touch or go within 20 miles of the Yosemite Valley. We are in the northern part of the park.

M. M. O'SHAUGHNESSY, City Engineer.

San Francisco.

Relativity—and Other Things

A Review of Half a Dozen Recent Scientific Books of Importance

By J. Malcolm Bird

SINCE that morning in November, 1919, when the newspapers carried the report from London that the eclipse photographs had been found in far better accord with the numerical predictions of Einstein than with those growing out of the Newtonian theories, there has been a deluge of books upon the foundations of science. Some of these have been frankly confined to the new doctrines of relativity; others have dealt in part with relativity and in part with broader subjects; others have had, on their face, no immediate bearing upon the bombshell which Einstein set off under the easy chair of the conservative scientist. But for the reviewer it is convenient to regard them all as part of the extraordinary revival of interest in this sort of thing which accompanied the persistent effort of the public to learn what Einstein was getting at. It is therefore convenient to review, in this one place, a number of these volumes which have been accumulating upon the editorial desk-top for—well, we are shocked to note upon carefully inventorying them that they have been accumulating there for a year or more.

Scientifically speaking, the most important of these volumes is undoubtedly that by Hermann Weyl. We had intended to give this book notice from the original German edition. Mr. Brose, however, whose industry is responsible for more than one translation of current German scientific works, has made this unnecessary. The volume appears in English under the title "Space—Time—Matter," and with the imprint (in America) of E. P. Dutton & Co.

We put the case mildly when we state that the book is not intended for general reading. Even for the ordinary collegiate mathematician there are stretches of many pages that would be quite unintelligible unless they had been led up to by a very careful reading of all preceding pages. It is one of those very distressing books in which the mathematical symbolism that the author must use is built up laboriously from chapter to chapter. But to one able and willing to read it through conscientiously from beginning to end it affords a complete and absorbing picture of the world, as the new science regards it.

It is not without its introductory sections, at that. It is divided into four chapters (American practice would make them "parts," and the "sections" into which they are divided "chapters"), of which the first devotes 64 pages to a discussion of Euclidean space—its mathematical form and its role in physics. Chapter II, of 74 pages, discusses the metrical continuum; Chapter III, of 79 pages, the relativity of space and time; and Chapter IV, of 77 pages, the general theory of relativity. For one who can master its necessarily elaborate notation without too much struggle, it affords an admirable treatise on the modern mathematical physics and the modern mode of tying up everything into equations of condition.

That this book has been through four editions in the original German proves one of two things—probably proves both of them, in fact. First that, contrary to one's first impression, the material, complex as its form and content is, is not beyond the range of a reasonably intelligent and—the terms are not synonymous—reasonably well educated person. Second, that the average German is quite a different creature intellectually from the average American. Granted that the upper layer of college graduates in this country ought to be able to read this book with profit, we think it no long jump to conclude that far too few of them will have the application to do so; and that it will most certainly not enjoy three reprintings in English. For those who can and will read it, it forms the best exposition of the current viewpoint toward the fundaments of science and the essential nature of things which has yet been brought out.

A volume of similar profundity but of somewhat different aim comes from the pen of Dr. Francis D. Murnaghan, through the Johns Hopkins Press. Dr. Murnaghan will perhaps be remembered as the author of the essay "The Quest of the Absolute," which failed to win the Eugene Higgins prize only because the judges felt that Dr. Murnaghan had been a trifle too free in interpreting the requirement that the essays be fit for popular consumption. He now writes on "Vector Analysis and the Theory of Relativity," producing what is admittedly a text-book. In a letter to the present reviewer, Dr. Murnaghan explains that he has "tried to touch the heart of the matter without being unduly mystifying." He thinks that "the book will find its principal use in university classes, but that there are a number of serious students of scientific inquiry" among our readers who might appreciate a notice of it. We agree with him.

We can say no more nor any less for this book than Dr. Ames says in the introduction. "One of the most striking effects of the publication of Einstein's papers on generalized relativity and of the discussions that arose in connection with the subsequent astronomical observations was to make students of physics renew their study of mathematics. At first they attempted to learn simply the technique, but soon there was a demand to understand more; real mathematical insight was sought. Unfortunately there were no books available; not even papers.

"Dr. Murnaghan's little book is a most successful attempt to supply what is a definite need. Every physicist can read it with profit. He will learn the meaning of a vector for the first time. He will learn methods which are available for every field of mathematical physics. He will see which of the processes used by Einstein and others are strictly mathematical and which are physical . . . The book has given me a definiteness of understanding which I never had before, and a vision of a field of knowledge which before was remote."

We may add that the book is the outcome of a course of lectures given at Johns Hopkins, and that its immediate mission in life is to serve as a text-book, carrying the student of the calculus into those little-known departments of the subject out of which the Einstein results flow. In our judgment anybody who has really mastered his calculus should be able to read Dr. Murnaghan's text with profit, and should find in it what Dr. Ames found.

Since our own volume—our obligations to our 300 contributors were stressed therein and need not be further acknowledged here—there have been few books of just this character: a reasonably short discussion for the strictly popular audience of Einstein's relativity and nothing else. There has been, to the best of our observation, just one other successful one. The author is one who on the basis of past performance is eminently qualified to write in this field—none other, in fact, than our own prize-winner, Mr. Lyndon Bolton. Asked by Messrs. Methuen to spin his winning essay out into book form and length, he has produced an admirable volume. He stresses the fact that he himself, in his preliminary wrestling with the subject, while perfectly able to follow the mathematical treatment was in much mental turmoil to satisfy himself just what it was all about. It was not until he had formulated an answer that he felt that he had mastered the new theory; and the answer which he had formulated supplies the thread along which he has spun his narrative. Relativity is the study of general physical laws in forms which shall be common to all observers; this is what he tells us at the start, and this is what he keeps before us at all times. His text is not wholly free from ordinary algebraic notation; but as we have once suggested, the person who does not understand how, and why, and when, it is proper to use letters as symbols for numbers, is certainly barred from an understanding of this subject. Mr. Bolton's book, published under the title "An Introduction to the Theory of Relativity" and handled in this country by Dutton, is in our opinion the best work in this field with the probable exception of the one in which the faults are all our own and the virtues those of Mr. Bolton, Dr. Murnaghan, and our numerous other essayists. And it is sufficiently unlike our volume to make the reading of them both highly profitable.

Just a word about a little volume by Einstein himself, "Sidelights on Relativity." This again is a Methuen publication, this enterprising British firm having made a very strong showing in relativity and allied fields. We must confess that it is a disappointment. We find nothing in it that Einstein himself, or somebody else, has not said as well or better, elsewhere. Still, the price is trifling, and many folk will doubtless enjoy the two lectures of which the book consists.

Next we come to the truly monumental work on relativity for the general reader—Lord Haldane's book. We regard it as no exaggeration to state that this is the most extraordinary volume that has come from any press in years. It leaves about the same impression on one as would Wells's "Outline of History," if one could read the latter with the assurance that—as is admittedly not the case—every line was the direct and unedited product of the one author. Lord Haldane demonstrates a range exactly comparable, in his field, to that which Wells would have displayed in his, had he been capable of writing the "Outline" all by himself.

The book is not mathematical in treatment, but rather philosophical; yet when necessary it dips into mathematics. It aims to survey the field of relativity in the whole and in all its parts, and in its bearings upon all allied topics. Sometimes the author goes so far afield in search of these that the reader is left to follow him with some difficulty, and with doubt whether he is not being led away from the subject. It is not clear, for instance, to the average mind, just what connection exists between relativity and human conduct. Lord Haldane, however, elects to regard Einstein's particular doctrines as but one phase of a much more inclusive mode of thought, and one which occupies a far more nearly universal field than does the mere mathematico-physical concept of the relativity of motion. "The Reign of Relativity," as the book is titled, rather suggests this viewpoint. The author has been at great pains to extend the boundaries of relativistic thought to the widest extremes of which they are capable, and to lay bare all conceivable philosophical ramifications of the subject. His book will suggest more brand new trains of thought than any other single volume with which we are acquainted.

The second-best instructor of collegiate mathematics whom we have ever known is utterly unable to carry to a successful conclusion an ordinary sequence of numerical operations. Having added, multiplied and divided, and reached an answer that is patently wrong, it is his habit to survey the board mournfully and appeal to his class—"Gentlemen, tell me; what have I done?"

Those of us who have gone through high school and acquired a smattering, more or less, of algebra and geometry, do not usually realize the limits which circumscribe the mathematical knowledge and sophistication of the average, reasonably intelligent citizen. One who has never gone beyond the "advanced" arithmetic of the grammar school is enormously puzzled to imagine what the subjects can be which are studied in college mathematics for years and years after graduation from arithmetic. He visualizes nothing more—he is incapable of visualizing anything more—than some fearfully complicated form of numerical calculation. And when we tell him of the brilliant mathematician who cannot add or multiply correctly, his bewilderment is raised to the *n*th power. How can such a thing be? is his only reaction; how can it possibly make sense to say that a man who cannot calculate is a good mathematician?

So much for one species of ignorance of the higher mathematics. Another species is that which afflicts the man who goes for a greater or less distance through algebra, analytic geometry, trigonometry and calculus perhaps, without ever discovering what it is all about—what are the central ideas underlying the structure. One finds such persons everywhere; from the class in elementary algebra in high school where they learn to juggle symbols that have no meaning to them, right through into the graduate courses in university physics, where persists the same uncanny ability to use tools without comprehension of their nature.

For some years, Dr. Cassius Jackson Keyser, Adrian professor of mathematics in Columbia University, has been giving a lecture course on the essential things of modern mathematics, designed for and primarily open to advanced students in philosophy, physics, chemistry, etc., who want to know more about their mathematics. Those who attend this course do not learn how better to differentiate and integrate, or anything like that. Dr. Keyser lectures to them on the philosophy of mathematics. But he tells them things which competent mathematicians too often never learn. He identifies and classifies and explains for them the basic ideas at the roots of the mathematician's work.

He has now published these lectures in book form,

(*Continued on page 70*)

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Radio on the Screen—A Review of the Scientific American Film

SOME time ago we announced in our columns our entrance into the motion picture field. We told of an arrangement between the Educational Films Corporation and the SCIENTIFIC AMERICAN for the purpose of producing scientific motion pictures which would be as instructive and authentic as they would be entertaining to the usual theater audience. The result of this fortunate combination is the film "Via Radio"—a single reel film which tells in fifteen short minutes what every person should know regarding present-day radio communication.

It is surprising with what ease an intricate subject can be explained even to the veriest layman by means of motion pictures. "Via Radio" rapidly unfolds the principles of communication, whether by means of light waves, sound waves, electric waves or radio waves. It shows how all these methods call for the production of vibrations at the transmitting end, and the interception of these same vibrations at the receiving end. The manner in which the human voice molds or modulates an electric current is clearly depicted, and the path of such a current across the United States, from the Atlantic to the Pacific via the trans-continental telephone line, is shown step by step.

So much for guided communication by means of electric waves. It is but a step from guided communication to unguided or radio communication. The film soon takes us into radio—so soon, indeed, that we are confronted with radio methods even before we have had an opportunity of becoming shy. And we soon learn, as the film story unfolds, that there is nothing formidable about radio, after all. It is simply a matter of generating electromagnetic waves by means of powerful high-frequency alternators, or by means of vacuum tubes, which are little more than large electric lamps with a few additional elements inside the glass bulb, thrown in for good measure.

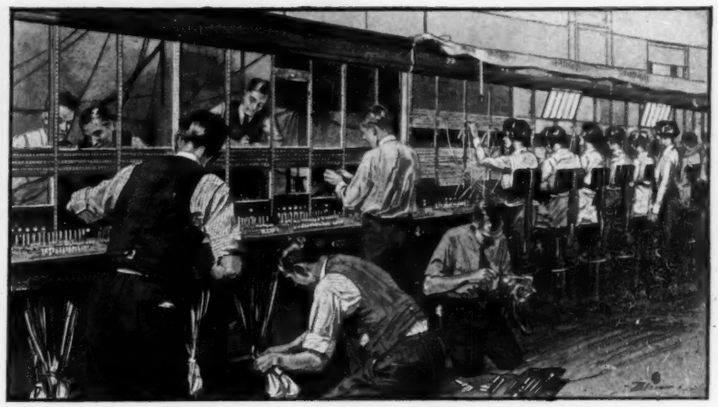
Radio broadcasting is every-day radio, of course. Not one person in a hundred typical citizens has the opportunity of coming in contact with workaday radio, except possibly in his daily newspaper, much of which is due to trans-Atlantic radio press reports. But radio broadcasting enters into the home life of many Americans, and it has come to be accepted as a very necessary part of the household. "Via Radio" devotes quite some footage to the radio broadcasting station, where the artists play and the singers sing, while the sounds are gathered in by an inconspicuous round metal affair with screened windows not much larger than a soup plate and standing upright on a table, which is known as the microphone. The microphone impresses the sounds on an electric current; that current impresses its variations on a more powerful current which in turn impresses the variations on the radio waves which are propagated in all directions from the station. At distant points the listeners intercept these waves, pass them through a little device known as the detector, which translates the electric variations back into sound waves.

Even static comes in for its share of glory—or shall we say disgrace? The effect of static on the usual radio receiving set is graphically shown in the film. Also, the interference of amateur transmitters, powerful commercial transmitters, and numerous broadcasting stations all going on at once, is forcibly brought out.

Some of the lesser known features of radio have been woven into the film, "Via Radio," in a most interesting fashion. Thus the radio compass is explained in detail. We learn how a ship, calling up a radio compass station, is located by means of two loops of wire, and the direction of both loops serves to determine the exact location of the ship on a chart. Telephoning from shore to ship is also shown in detail.

All in all, "Via Radio" tells the story of radio and tells it well. The action moves along briskly and at no time is there too much explanation or petty detail. Yet the film is not to be considered as superficial, for all that is really necessary for a general understanding of the subject will be found in the film. Finally, the best proof that the film sustains interest throughout is that it finishes before one expects it to finish, although the story has been completed.

The film has been produced at the Coronet studio in Providence, R. I., with the full cooperation of the SCIENTIFIC AMERICAN editorial staff from the planning and writing of the scenario, to the cutting and editing of the finished film.



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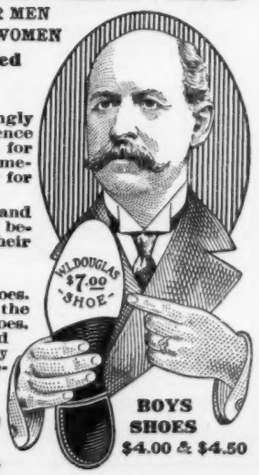

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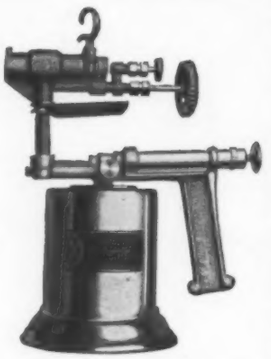

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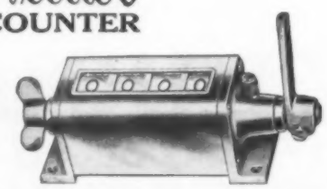

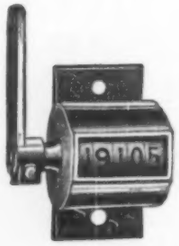

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Science Notes

Horn Sounded for 1000 Years.—Ripon, England, keeps up a custom 1000 years old. Every night a "wakeman," attired in official costume, appears before the mayor's house and blows three solemn notes on the "horn of Ripon."

An Observation on the Jungfrau.—Some Swiss scientists having proposed to build an observatory on the top of the Jungfrau. The Swiss Meteorological Bureau has carefully studied the proposal and decided that, should the observatory be created, it ought to be placed on the Sphinx rock.

Sleep by the Compass.—A European doctor, who recently died at the age of 109, attributes his longevity to his method of sleeping. He says: "When you go to bed always take a compass with you and with the aid of the compass place your bed in such a position that your head points directly north and your feet due south. Sleep soundly in a horizontal position and you will live long."

The Noise Evil in Germany.—Paternalism is carried to extremes in Germany. A hotel proprietor was recently restrained from chopping meat bones before 8 A. M., on account of nervous frequenters of the resort. A bowling alley may not be conducted after 10 P. M., or a cabaret after 11 P. M. The curious thing is that in Germany, whether the person discommoded by the noise moves into the disturbed zone or not makes no difference. The very fact of taking residence next to a sawmill would give abundant cause for action. What we need in this country is a "Oberverwaltimgsgericht" of the Prussian brand.

The Walnut and the Squirrel.—Squirrels are responsible for the appearance of nut-bearing trees in unexpected places; they are forgetful little elves, and many of the carefully hidden nuts they have cached for the winter are overlooked, germinate, and become trees. Walnuts, because of their large kernels, are especial favorites with the squirrels; these trees are troubled by few pests, furnish fine shade, and are commercially valuable; the timber makes excellent airplane propellers and gun stocks. The war thinned our resources in black walnut down to 820,000,000 feet, and half of this is inaccessible for commerce.

Another German Prodigy.—Germany has another memory prodigy in a 21-year-old girl, who has mastered the art of brain control over muscle most completely. She sings a German song, writes an English sentence with her right hand, and a French sentence with her left hand at the same time. Also writes a sentence in one language backwards, and another in a different language in the regular way. She can calculate with one hand and write dictation backwards with the other. She can also begin a sentence at both ends and complete it in the middle, using both hands. She does several other things which really seem beyond the limit of credulity.

The Conquest of Kilimanjaro.—Kilimanjaro, Africa's two-headed giant, has again been climbed, this time by two Englishmen, Gillman and Nason. Mount Kibo, the higher of the two heads by some 2000 feet, was selected for the adventure. The slopes, covered by loose shingle, afforded but a slippery foothold; above this zone, progress could only be made by chopping steps in the ice. Persevering with superhuman efforts, the rim of the ice-filled crater was finally reached; here were found, in a good state of preservation, the cards of German climbers who had forestalled the Englishmen. At about 19,500 feet the pulse was 120 to 130, and breathing was 35 to the minute. Boiling-point observations were also made, and many photographs were taken.

Research in South America.—The Field Museum of Natural History is equipping six expeditions. Two will gather geological specimens from Brazil to Patagonia, while two others will study plant and animal life in Peru. Archaeological investigations will be pursued in Colombia and the Isthmus of Panama, and another party takes up the ethnology of the Malay Peninsula. The gems and minerals of Brazil and the silver, copper, nitrate and vanadium deposits of Peru and Bolivia will be carefully explored. Specimens of pre-historic vertebrate life will be sought in the Santa Cruz beds, and the great ground sloth and the pampas horse may be represented in the finds. The archaeological expedition aims at solving some of the mysterious interrelations of ancient civilizations and may provide a connecting link between the Maya and the Inca.

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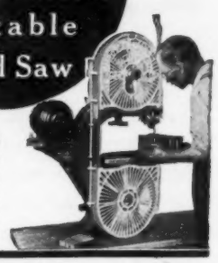

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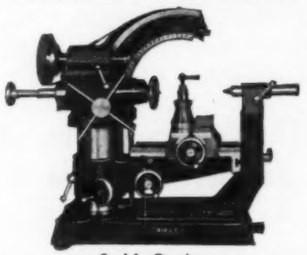

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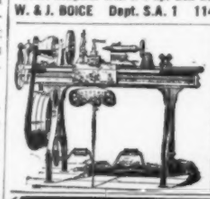

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(*Continued from page 7*)

we specify that a psychic photograph, to qualify for our award, must in the opinion of the judges represent distinctly the human form or face—with permissible attachments such as the wings of Doyle's fairies. The decision of the judges as to whether this requirement has been met must be final.

Instrumental Control

So much for psychic photographs. In the general class, we indicated in our preliminary announcement of December that phenomena to qualify must be visible. We shall go further than this in some directions, not so far in others. We have satisfied ourselves that for practically all the psychic phenomena now in vogue there exist or may be devised instrumental tests. If the graph says that the table was off the floor; if the microphone says that sounds occurred, and tells us where; if the galvanometer records the presence of something where the "spirit" was seen—then we know that something has happened, and that the phenomena were not mere hallucinations. If at the same time the medium is shown instrumentally to have been where the phenomena were not, the question of his active interference is largely settled. The psychic investigator should never rely upon the evidence of eye and ear and touch. No matter how keen an observer one may be, the conditions of a seance are never those for ideal observation; and if they were, it is an uphill fight making all the rest of the world believe that one really saw what one says one saw. "Collective hypnotism" may be, as Dr. Carrington confesses he more than half believes, a mere phrase; yet it affords a delightful mouthful for the lay critic who does not find it convenient to accept the results of psychic research.

A second feature of instrumental control that impresses us is its adequacy to settle at one stroke all the problems of the seance room. We know that there are, among psychic phenomena, numerous effects that are wholly mental and others (admitting for the moment their existence) that are physical. We know that the dividing line is hard to draw. Why not let the instrument decide? If an instrument exists or can be devised that will record the occurrence of the thing that is alleged to occur, that thing is a physical phenomenon—of psychic origin or not as subsequent investigation may determine. If the instrumental check has to go by default, the phenomenon is not within the scope of an investigation of this character.

Again, the question of objectivity. We know approximately what we mean by this; yet a rock-ribbed definition is just about as possible as a rock-ribbed definition of the scientist's simplest term, of which the present writer has already had something to say, both in these columns and in the book growing out of the Einstein contest. But if we agree that susceptibility to an instrumental test is the criterion for objectivity—there you are!

Accordingly the general-class award will be made to the first medium who produces a psychic phenomenon, as already defined, of such sort that a permanent instrumental record can be made of its occurrence. This includes raps. We can prove that they occurred, we can prove where they occurred, we can prove where the medium was when they occurred—and that's plenty. It includes practically everything of a telekinetic nature—the exertion of physical force without contact. We will find a way to make it include the production of "ectoplasm." The only thing which we should like to include and of which we are not sure is the "psychic lights." Apparently these are of insufficient candle-power to be photographed during their brief period. Dr. Comstock has hopes of finding a way to record them; if he fails, they will have to be excluded from the phenomena for which the general award will be directly made. They will, of course, be investigated as they occur alone or with other phenomena. If they and other manifestations which seem of physical nature have to be ruled out, our mediums will understand that this is only because we do not find them susceptible of proof in the style and to the degree which we have set ourselves.

The physical phenomena do not exhaust the subject of psychism. Indeed, certain mental phenomena seem to be of greater significance and, for the present, in a more satisfactory state of proof, than any of the physical ones. We do not know to what extent we shall carry our psychic program

(*Continued on page 67*)

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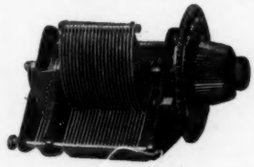

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Miscellaneous Notes

Salt from Palestine.—Preparations are being made to obtain salt from the sea on a large scale at Athlit, about 10 miles south of Haifa, in Palestine.

The First Channel Flight.—A monument on the highest point of the cliffs, between Cape Grisnez and Sangatte, in memory of the airman Latham and the first attempts to cross the Channel by airplane, was unveiled on August 13.

Motor Trucks on Farms.—More motor trucks are used on the farms in the West North-Central States than in any other section of the country, according to figures of the United States Bureau of the Census. Minnesota, the Dakotas, Iowa, Missouri, Kansas and Nebraska alone have 33,000 trucks on farms.

Rome After the Speedsters.—In Rome the narrow streets and steep hills render motoring rather precarious at best and there is no room for the speed maniac. An automatic regulator which will limit the speed within the city proper is being seriously considered. This invention depends on a type of governor and is the result of the inventive labors of Messrs. Fragano and Villa.

An Inventor of a Famous Toy Dies.—Fräulein Gretel Steiff, who brought joy to so many million nurseries, is worthy of mention in these or any other columns. The invention by her of the "Teddy Bear Doll" will go down into history with Rose O'Neill's "Kewpies," the "Kiddie Car" and a few other little things which make life happy for children. The inventors' toll on such devices is enormous.

Made a Colossal Fortune in Scrap Iron.—A Frenchman has just appeared before a Paris court charged with concealing $180,000 war profits to escape taxation. When war broke out he kept a small cafe at Saint Denis, his wife attending to the inn while he peddled with a push-cart. He bought old scrap iron and made so much money that he paid $5,400,000 for the war stock of the American camp at Romorantine.

A Plague of Grasshoppers.—France has had a grasshopper pest of unparalleled severity. They have not only destroyed crops but, according to cable dispatches, they have interfered with train service as well. The insects appeared in such numbers that they blocked train service between Niort and Fontenay-LeComte, a distance of over thirty miles. So thickly were they massed in this region that it was necessary to stop trains frequently to clear the tracks. The train crews were supplied with special implements for this purpose.

Children at Work.—The Department of Commerce announces that the total number of children of 10 to 15 years of age, inclusive, engaged in gainful occupations in the United States, as enumerated at the Fourteenth Decennial Census, taken as of January 1, 1920, was 1,060,858, comprising 714,248 boys and 346,610 girls. The boys reported as gainfully occupied constituted 11.3 per cent of the total of 6,294,985 boys aged 10 to 15 years, inclusive; and the girls reported as gainfully occupied represented 5.6 per cent of the 6,207,597 girls within the same age limits.

Bogus Antique Ivories.—Many returning tourists delight in having acquired antique ivories, packed in leather-covered boxes, often bearing the crest of some noble French family. They are, however, the victims of a new school of "bone sculptors" which is making Paris its center. The "artists" are specializing in imitations of carvings executed between the ninth and sixteenth centuries. It has been found that by simply boiling in infusions of tobacco juice and an alcoholic infusion of raisin seeds or washing in hydrogen peroxide, followed by an oven treatment, it is possible to give the finest coloring of age in a short time.

A Novel Child's Barber Chair.—An innovation combining comfort and distraction for the child who is having his hair cut is known as the "kiddies' auto barber chair." This is a perfect miniature automobile, having an adjustable steering wheel, a lever on the inside which opens the door, a brake on the outside which regulates the mechanism for lifting or lowering the auto chair to the desired height, adjustable foot rests to suit the size of the child and comfortable spring upholstered leather seats. The cars are made of sheet metal on hardwood frames, and are painted and enameled in different colors. The child may suit his fancy in picking out any well-known car models.

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Civil Engineering Notes

Contractors Have Lost Many Lanterns by Theft.—An engineer of a gas company in California has adopted a novel method of minimizing the stealing of lanterns. He takes an ordinary lantern and casts a cement block around the base, 10 inches square and 4 inches thick. An opening is left so that the reservoir of oil can be filled. The wire handles are also removed so that the lantern is of very little use to any thief.

New Testing Machine.—The Engineering Laboratory at Armstrong College, Newcastle-on-Tyne, has been equipped with a new testing machine for bending and compression. Columns 10 feet in length, and beams 9 feet in span, with a maximum width of 4 feet, can be handled in this machine. In previous testing machines the width of the member that could be handled was limited to a few inches, and the width of 4 feet, which can be accommodated in this machine, is one of its special features. The maximum load of 60 tons is obtained by hydraulic power, and the measurement is in steps of 25 pounds on a graduated steel yard.

A Study of Reverse Stresses.—Professors Moore, Kommers and Jasper, of the University of Illinois, in a paper on "The Fatigue of Metals," state that during a series of tests which are now being made, specimens withstood 100,000,000 reversals of a stress close to the limit of endurance of the metal, and then were subjected to additional reversals at somewhat greater stresses, and these metals have withstood a second series of 100,000,000 reversals of this greater stress. The remarkable fact was brought out that specimens which had withstood the above stresses were subsequently subjected to static tension tests, in which they showed higher tensile values than those shown by the same material before the repeated stressing.

Ship Canal Across Scotland. — The project for the construction of a ship canal across Scotland, between the Clyde and Firth of Forth, has been brought to the front again in a recent meeting of the Mid-Scotland Ship Canal Association, which took place at the Royal United Service Institution. Two principal schemes have been proposed, one by the direct route; the other, which avails itself of existing waters, is known as the Loch Lomond route. It developed at the meeting that the experts are divided as to the relative advantages of the two routes, and it was agreed that what is needed is a commission which should include expert engineers, representatives of shipping, and of the British Admiralty. A selection of the best route would be made by this commission, whose word would be final.

Impermeable Concrete with Steel Powder.—As the result of experiments undertaken by the Queensland Railways in the search for an impermeable concrete for lining reservoirs, it is stated that the use of steel powder not only rendered the mortar or concrete more impermeable but added to the resistance and hardness of the mix. It is recommended for use in concrete placed in either fresh or sea water because the metal seems to fix the cement and cut down the chemical action of the water. The sand used in the mix should be chosen with the greatest care. Half as much steel dust, which replaces part of the sand content, is used as is cement in any particular mixture. Care must be exercised in the mixing, and the consistency should be, according to the bulletin describing the experiments, "semi-liquid."

Riveting Pressures.—Tests of the effect of riveting made by Professor R. Baumann (*Zeitschrift des Vereines deutscher Ingenieure*, May 20) indicate that both the thermal stresses and the stresses caused by high riveting pressures have a tendency to open up cracks in the plates connected. To obtain an estimate of the thermal stresses, comparative tests were made with hot-driven iron rivets and with cold-driven lead rivets, which showed that the temperature stresses exceed the others. A high riveting pressure is likely to produce stresses in the plate exceeding the yield point. The plate reaches temperatures exceeding 500 degrees Centigrade during riveting, and large temperature stresses result from this heating. The most unfavorable stress conditions occur at the faying surfaces, between plates in contact, directly adjacent to the rivet hole. The stresses are largest in the case of rivets close to the edge of the plate.

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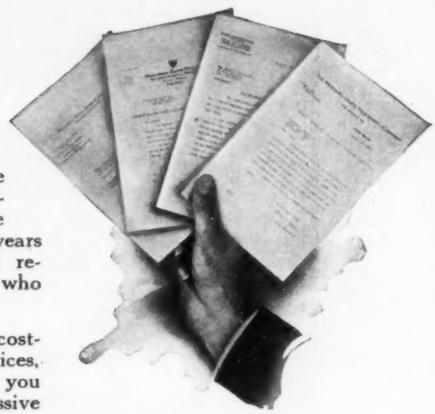

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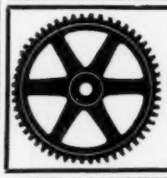

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Mechanical Engineering Notes

Noiseless Riveters operating on a rotary vibratory system are now offered, of bench or pedestal type, which it is claimed will rivet the most intricate job in silence, at a speed limited only by the operator's ability to feed the work.

Double-Ended Shears for metal cutting are among the time-saving mechanisms of the day. When one end is closed the other is open, and vice versa, the secondary cutting heads bearing the same relation to the primary ones that the handles of an ordinary scissors bear to the blades.

The Importance of Cleaning is never so strongly demonstrated as when, as has more than once happened, production has to stop because the cleaning department cannot get the product of the machines clean enough so that it will take the japan, paint, or other finishing material.

The Chain-Drive is familiar to many users of mechanical power on the basis of its flexibility and positiveness—properties which it is difficult to combine in such degree in any other mechanism. Comparatively new, however, is its application to small motor work. Material savings in power and materially longer life are claimed for it in this application.

Building Up Worn or Undersize Parts by electrodeposition of iron was developed during the war by the British army repair shops, and employed with success in automotive machinery, aviation engines, etc., using the cold sulfate bath and the low-current density method. Experiments along the same lines have now been undertaken at the Westinghouse Research Laboratories in this country, and the British results have been confirmed and extended.

A Tap has been put on the market which makes tough steel plate work easier. Instead of having tapered chasers it is provided with short straight chasers, that automatically recede as they advance into the hole. A cam moving along the correct angle controls the chasers and produces the proper taper. The result, it is claimed, is clean, perfect threads and minimum power consumption.

Hack-Saw Breakage is analyzed by a prominent British engineer, who attributes it to the following causes: Faulty blades, 3.2 per cent; gross carelessness by operator, 29.4 per cent; wrong blade for job, 17.3 per cent; wrong speed on stroke, 21.6 per cent; wrong pressure, 28.5 per cent. In the light of this showing it would seem that ignorance and carelessness on the part of the operator is a pretty expensive indulgence for his boss.

For Handling Coil Stock.—The loading and unloading of heavy coils of wire or rod-stock, never a simple proposition, is expeditiously effected by means of a novel conveyor developed by a Wickliffe, Ohio, concern for use with its electric tramrail system. The coil conveyor is in the form of a steel hook about eight feet long, and will carry a ton of rod-stock at a time. In conjunction with electric hoists it makes the loading and unloading of this sort of metal cheap and easy.

Cam-Driven Feed Mechanisms form the subject of an interesting discussion by A. L. De Leeuw in *American Machinist* for October 19. The author lays down a number of illuminating general principles which are not, perhaps, as clear in the minds of designers as they might be. He emphasizes the extreme flexibility and the complete reliability of the complicated single cam, or series of cams on a single shaft, for carrying off the successive operations of a long cycle. The article is altogether a suggestive one, and one which may profitably be studied by every designer or user of complicated machinery.

The Use of Copper and Brass is urged on a more extensive basis in recent advertisements of a research association in this field. The list of possible uses given with the advice to check it and see whether you are getting the full service of the "everlasting metals" includes ball races, bearings, belt lacing, boiler trimmings, bus bars, condenser tubes, conductors, connecting rod brasses, controllers, feed water piping, floats, gaskets, gage castings, hand rails, lubricators, oilers, oil strainers, packing glands, piping for oil circulation systems, pump liners, pump rods, shims, soft hammers, stop cocks, switches, turbine governor parts, valves, valve trim, water gages, whistles, wire, and, lest we conclude that the possibilities have been exhausted, two "etceteras" and several extremely general items such as "electrical fittings."

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Radio Notes

Comparative Efficiencies of Various Transmitters have recently been determined at the Eiffel Tower station in Paris, according to a report in the *Engineer*. It is reported that the efficiency of the musical spark transmission is 47 per cent, and that of the Poulsen arc system 29 per cent. If, however, the Poulsen arc is employed with no compensating wave, its efficiency rises to 45 per cent. At the station at La Doua, near Lyons, experiments were made in order to establish the cost of transmission with the Poulsen arc and with the high-frequency alternator. The latter apparatus appears to be much more economical than the former, the alternator requiring only about 54 per cent of the energy required by the arc. The care required by both types of apparatus, the accidents in their working, and the sundry expenses have been minutely analyzed, and the results appear to favor the use of the high-frequency alternator, for the present, at least.

International Efforts to Reduce Radio Interference.—Countries which are employing radio communication in rapidly increasing degree have been compelled to arrive at a mutual understanding in order to avoid interference and delay in traffic. Five different types of waves have been standardized which produce various amounts of interference at a given distance from the transmitting aerial, the decrement serving as a criterion. Thus radio telephony is to be carried on by waves ranging from 1550 meters to 1650 meters for fixed stations, and 300 meters to 340 meters for mobile stations, but the decrement of the waves used must not be greater than 0.005. For mutual benefit, continues *Electrical World*, it is proposed to ask every nation represented at the next international conference in radio communication to supply particulars not only of stations in use, but also of projected stations that may be erected in the succeeding five years.

Radio and Wire Telephone.—The operation of the ordinary wire telephone is compared with the operation of the radio telephone in a recent issue of the *General Electric Review*, by way of explaining in easy stages the meaning of radio communication. It is brought out clearly that the two systems have four primary units in common—some sort of energy conductor between stations, some form of energy capable of being modulated to conform with sound waves, a transmitter and a receiver. Since the type of radio equipment discussed utilizes primarily the vacuum tube, a section of the article is devoted to a description of the principles and characteristics of this device. The rest of the article shows how the transmitter modulates the radio-frequency carrier wave that it broadcasts, how the receiver by rectification of the otherwise inaudible incoming wave reproduces the sound wave and how amplification is accomplished. The article is well worth reading, if one would obtain a good elementary knowledge of radio.

Radio and Central Stations.—At the recent New England convention of the New England division of the National Electric Lamp Association, T. Johnson, Jr., of the General Electric Company, pointed out that the use of separate antennae gives better results in radio telephony than the development of utility distribution circuits for reception of waves by owners of modern sets for use with broadcasting station service. Broadcasting over central-station mains is as yet comparatively undeveloped. Recent carrier-current experiments have used frequencies up to 20,000 cycles, but if these are employed on circuits having gaps, secrecy is lost at the gaps. Four carrier-current sets of the 50-watt size will soon be installed for central-station service in New England, according to Mr. Johnson. Carrier-current equipment is now available for use on lines as long as 85 miles with no intervening tie-ins. Each tie-in reduces the range of transmission by about 10 miles because of reflection. Apparatus is being developed for 260-mile transmission, using a 250-watt transmitter. For straight radio telephony in central-station service with a range of 50 miles upward the antenna should be from 175 feet to 200 feet high and about 200 feet long. It should be remembered that reliable service when wire lines are not available demands a very high standard of construction in the radio field. About 200 watts are required for 100-mile radio telephony, and with this amount of energy radio telegraphy can be carried 400 to 500 miles.

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Electrical Notes

New Life for Burned-Out Lamps.—In a recent issue of *Zeitschrift für Beleuchtungswesen*, there appears a review of the many possible methods of renewing the broken or burned-out filaments of incandescent lamps. Four main methods for such renewals are shown: (1) The glass bulb may be made with a joint in the first place; (2) the bulb may be opened at the exhaustion tip; (3) same as in (2), but additional openings are made near the base of the lamp; (4) the bulb is cut open along the base and afterward resealed. The fourth method is being used to some extent in England and Germany, where the present high cost of new lamps makes the renewing of old lamps a commercial success.

Underground Power Cables Without Conduits.—A new type of power cable has now been brought out, with metal sheath, double layer of flat steel armor and asphalted jute covering, thus offering a means of placing power circuits underground without conduits. The installation of this new cable is simple. It is only necessary to dig a narrow trench, 18 inches to 24 inches deep, lay in the cable and cover up. The lead sheath, double steel armor and asphalted jute give permanent protection. No separate conduits are necessary. The cable eliminates the expense of poles, crossarms and insulators which are necessary in overhead lines, and eliminates the high cost of maintenance, to say nothing of the unsightliness and obstruction of pole lines.

A New Resistance Material.—A mixture of quartz and carbon fired at temperatures between 2000 and 3000 degrees C., results in a metal carbide which can be formed into rods or tubes. The temperature-resistance coefficient of such a rod is negative up to 600 degrees C., then becomes positive up to 1000 degrees C., and changes finally again into negative. The material can be used as a heating resistance up to 1700 degrees C. At the ends, where the rod clamps into clips, the material is metallized to insure a good heat-resisting contact. Owing to its remarkably low expansion coefficient, continues *Electrical World*, it is possible to pour water on a glowing rod without its cracking, or the rod can be brought to incandescence under water. These rods are being used in Switzerland on a number of air heaters, ranges and commercial ovens.

The Radio Loud-Speaker in a New Role.—An interesting installation has recently been completed for the Piedmont High School, Piedmont, Calif., involving a distinct improvement over present methods of inter-class communication. The equipment consists of a central or master station and twenty-five receiving stations, each equipped with a loud-speaking horn. The motor-generator and battery are installed in a steel cabinet in the basement of the school building. The master station is operated like an ordinary telephone. Talking into the instrument in usual tones, the speech is amplified in any or all of the twenty-five classrooms in sufficient volume to be distinctly audible to all the students. Radio entertainments can also be heard over the system if desired. It is announced by the manufacturer of the equipment that similar installations have been developed for hotel, railroad terminal and other commercial uses, but this is the first application of the loud-speaker to school service.

Heating of Fine Wires.—According to a recent issue of the *Engineer*, we learn that during a systematic research upon the heating of fine wires Professor Imhof of Winterthur, noticed a curious phenomenon when he used alternating current as a heating agent. Fine wires, stretched between clamps, and heated to incandescence by alternating current, were found to exhibit transverse vibrations of a considerable amplitude. The nature of the vibration depends upon the frequency of the current, the section and length of the wire, the composition of the wire, and the tension of the wire. Thick wires do not vibrate; wires of metals with a high coefficient of thermal dilatation vibrate with greater amplitude than wires of less expansive metals. The cause of the effect has been definitely ascertained to be the periodic cooling caused by the passage of the current through the zero value twice in each cycle. Every time this occurs, the radiation and consequent cooling of a fine wire are sufficiently rapid to set up a contraction. These contractions, repeated periodically, build up until they give rise to a periodic vibration of considerable amplitude.

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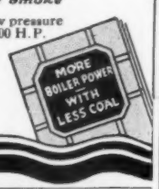

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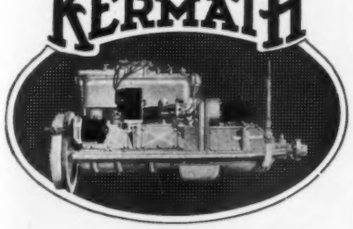

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Our Psychic Investigation

(*Continued from page 61*)

beyond the minimum requirements of the present announcement. If large results are obtained, with larger ones in prospect, we shall certainly not stop just because we have given a hearing to every medium who has been attracted by our offer. In the absence of large results, if the public interest and the interest of the small minority who possess the mediumistic ability to help us remains keen, we shall again be willing to go further than our immediate present program. We can even picture conditions under which we should want to expand the program before the present offer has expired. In any such event, we shall look upon the psychic phenomena of the mind as affording one of the more important of the avenues into which our investigation might be extended. Among the mental phenomena thus excluded for the present we class all communications by voice, writing, or other means which cannot be objectively distinguished from the same means as normally employed by the medium in his own conscious personality.

In the Seance Room

As with the psychic photographers, we hold the door open to the widest variation in procedure on the part of our general-class mediums. A few general principles may be laid down, however. The committee will be very reluctant to sit in absolute darkness, and will not so sit unless assured of adequate observation by other means than the visual. It is within the possibilities that the degree of lighting permitted by two successful mediums might settle the issue between them.

It seems probable that Palladino possessed powers of some sort, and descended to subterfuge only when these failed her. The Hyslop report on Ada Besinnet, again, brings forward the strong probability that some mediums, if not this one, commit fraud in secondary personality when they are not chargeable with the intent to deceive. We shall accordingly divide fraud into two categories. That carried out with arms, legs, etc., and without external aid of external apparatus will carry no penalty save a greater rigor of observation in subsequent seances. That carried out with the aid of any object brought into the seance room, however, is necessarily premeditated and when detected will result in disqualification. The medium will, of course, be subjected to a competent search, before or after the seances, at the pleasure of the committee.

At the present moment no further specific requirements occur to us that can be laid down for seances in general. It will be understood, however, that the committee will confer with every medium, canvass his procedure, and lay down the conditions under which it feels that it can carry on adequate observations. These conditions, as indicated above, will be modified to meet the medium's desires so far as is compatible with the committee's ideas as to the necessities of the case. No test or procedure will be applied that has not been outlined to the medium, though the committee will not undertake to inform the medium in all cases whether certain tests are to be attempted at certain seances. In the event of any tests having been objected to by the medium on the ground of possible injury to him, however, such test will not be made without his consent: but the committee will not undertake in all cases to refrain from counting a refusal to the medium's partial discredit, if there seems no other way of securing the information at which the test in question would be aimed. Other conventions will perhaps have to be laid down from time to time, or specific agreements entered into with given mediums, covering conflict between what the committee wants to do and what the medium wants done. The general principle, already enunciated, will always apply: That the committee will go just as far to meet the medium as it can, save at the cost of inadequate observation. It will always be willing to discuss with the medium the aim of any particular test, and the possibility of substituting a less obnoxious way of gaining the same end.

Inventor vs. Forger—II

(*Continued from page 9*)

check in the sun, irons it on the glass with his thumb nail, puts it back into the office machine, raises it to the highest amount possible, pulls it out and presents it to his audience with a flourish.

"If you don't think that'll pass your bank you're crazy," he says.

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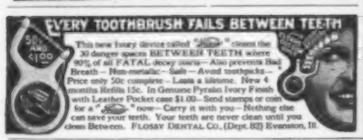
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Unquestionably these demonstrations have an evil influence on weak types of men, such as are often found in clerical forces. Suggestion is the mother of all action, good or evil. It works ruin in the minds of these unhappy fellows. I believe the better grade protector companies now discourage such feats on the part of their selling agents.

I have, however, not set out to make a case against the mechanical check protector. The most reliable manufacturers now state the situation with sufficient clarity when they candidly announce, as they do in their circulars, that mechanical devices are not infallible and that, to cover unusual cases, check insurance is advisable. Some manufacturers now sell you an anti-forgery and anti-raising policy with their machines.

Here the reader must be asked to realize that the forces of honesty and law are brought to three defeats at once. Banks still use safety paper for their checks, the most elaborate and delicate kinds, in many cases. Banks and business houses still use patent inks and no expert would advise against them. In addition they all employ the better kinds of check machines. If, now, it is admitted that one must insure himself to be really protected, this is an acknowledgment of the defeat of the paper, the ink and the machine.

The effect of such statements as these, whenever I have written them in the past, has been to flood me with letters from malinformed inventors with plans to make checks safe from the raiser. Most of the ideas that come in are ridiculous. On the other hand, I have seen excellent suggestions that look, on their face, like partial solutions of the problem. But everything that has ever been sent me or rumored to me falls down before one apparently impassable barrier.

The banks want to see the use of the check extended as far as possible. That is their business. Necessarily they must frown upon any plan which may tend to make the drawing or issuing or cashing of checks either intricate or difficult or subject to many blunders. A check must be a thing that an unintelligent person, a woman with no business experience, a man who can barely write or an unlettered foreigner may draw reasonably well. Originally a check was nothing but a slip of paper on which a depositor wrote to his banker:

"Dear Sir: Please to pay to John Jones the sum of ten (10) dollars, and charge to my account."

Something quite as simple is the ideal and the modern bank check is hardly more than this. It has simplified the operation by printing in advance everything but the amount, date and signature. The problem is, of course, to devise something that will balk the crook and at the same time not complicate matters. It might be easy enough to get up a check so involved that raising it would be next to impossible, but drawing it would be complicated to the same extent and the convenience of which the banks prate so much would disappear from the check system. The shoe pinches just here.

Meantime the bankers are not making much of a stir. Since the fashion in check alteration has turned largely to raising and the bulk of the loss has fallen upon the depositors the financier naturally feels that he can better stand his share of the stealage than make any foolish experiments with his checks. No doubt he is right.

While I have said that forgery went out of existence or retired into the background some time ago, it has come back to the fore again. Today nearly all big check raisings are accomplished by acts of forgery. The difference is that the payer's signature is no longer forged. Instead, the modern check man steals his checks from the mail, raises them to a high figure and then forges upon their backs the endorsement of the payee. In this manner he gets the money. So the operation is really a mixture of forgery and raising. The banks are not without responsibility in such cases and the losses are not necessarily those of the makers only.

On the other hand, one of the recent developments in check manipulation is called alteration of the payee line, *i. e.*, the name of the person to whom the money is to be paid. A great deal of this has been done by office men who found themselves unable to change the amount line, to which all the

(*Continued on page 70*)

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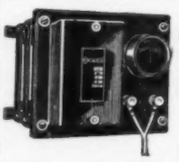

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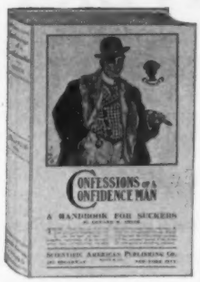

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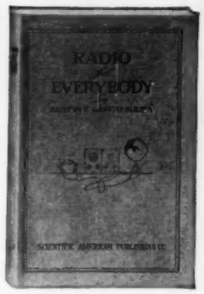

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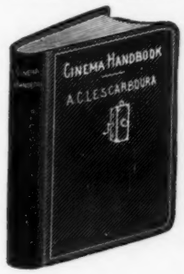

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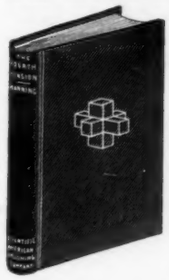

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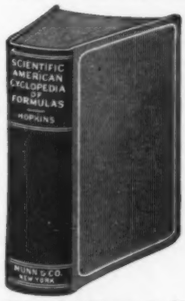

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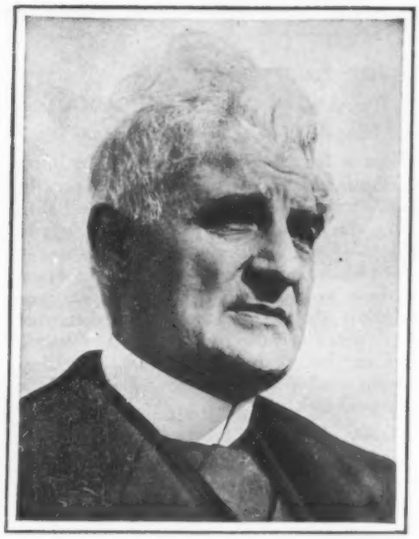

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Inventor vs. Forger—II

(*Continued from page 68*)

attention of the check protector is usually devoted. They have simply deleted the name of the true payee on large checks and substituted their own, without otherwise altering the paper. Such altered checks are easy to cash. The depositor is the loser.

Accordingly, the national situation as regards the bank check holds out rich opportunity for two classes—the insurance man and the inventor. While the latter is still dreaming over the miraculous device the former is making hay. Most of the great business houses now carry heavy insurance to indemnify them against forgery and raising. They have been able to find nothing so good and have naturally extended the surety bond idea from their employees to their check books. This plan has only one drawback. I wonder if the carrying of insurance will not make check writers as careless and perhaps as venal as it has made automobile owners, for instance?

To sum up for the inventor: There is a crying need for some really effective form of check protector or plan of check protection. To be adopted, the device or plan must be almost magically simple and free from the suspicion of making check writing difficult. What form this wonderful thing is likely to take is beyond my divination. It seems to me, however, that mechanical protectors or machines which seek to make the amount line safe from raising cannot win the great prize.

Not long ago a check raiser working near New York City got a laundry wagon driver to turn over to him a few checks collected from merchants, giving the driver cash and a tip in their stead. The raiser took these checks to his room and looked them over. He found that five or six of them were on the same bank and got a check-book of this institution by starting an account. He then took the original checks of the merchants, copied them in exact duplicate, including their numbers, on blank checks from his newly procured book, forged the merchants' signatures upon these duplicates either by tracing or by means of muscle forgery, and sent them through the bank. Every one of them passed without notice and was returned cancelled to its supposed writer at balancing time.

The raiser then allowed some weeks to pass. Next he took the half dozen original checks, erased them at the payee and amount line, made them payable to himself and raised them to great sums. After calling up the bank on six different occasions, saying that he was the credit man of a prominent department store or jobber and asking if the various merchants were good for the amounts to which he had raised their checks (information which the bank cheerfully gave), he deposited the raised paper, drew out his whole account when these moneys had been credited to him and fled.

It will be apparent that such a man need not raise the work of a mechanical protector to beat it. All he needs to do is to get hold of authentic checks and a machine of the kind used by his victim. He may then take a blank check of the same sort used for the original, copy the good check upon it, write in whatever amount pleases him, run the check through his machine, destroy the stolen original check and cash the forged duplicate. He thus circumvents the machine completely. If anyone should produce an unbeatable mechanism, the crooks would get around it in just this way. The defeat of the machines is thus already provided for, it seems to me.

Relativity—and Other Things

(*Continued from page 58*)

under the title, "Mathematical Philosophy." A sub-title tells us that the volume is one of "lectures for educated laymen," and the phrase is a most happy one, if we but remember that the "layman" in mathematics is doubtless a specialist in his own particular field. This reservation is really necessary, for the man who is a layman in *every* field is a dabbler, and entitled to no great consideration from Dr. Keyser or anybody else. In the volume under review the nature of postulates and fundamental concepts, of which we have ourselves had a little to say in these columns, is discussed with thoroughness and lucidity, and the exact status made clear of the logical structure which the mathematician builds up of these. No less than 150 pages are thus devoted to showing the essential nature of mathematics. Then some of its collateral concepts are treated—such things as transformations, invariance

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Lawusa Returns to Her Village. *By R. W. Cilento*
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Looking East from Moscow. *By Ernestine Evans*
Is Russia successfully spreading Soviet propaganda in the East?

Mahaban and Sri Krishna. *By James Bissett Pratt*
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and groups; variables, limits and infinity; hyperspaces and non-Euclidean geometries; and finally the very close correlation that exists between mathematics and psychology, and which we have seen adequately discussed nowhere else. The educated layman to whom the book is addressed can hardly fail to take away from it a very definite idea of just what it is beyond mere figures that occupies the mathematician's mind.

Perhaps we may, in Dr. Keyser's case as in Dr. Murnaghan's, quote the preface:

"Though the course is designed primarily for students whose major interest is in philosophy, I venture to hope that the lectures may not be ungrateful to a much wider circle of readers and scholars.

"To the growing class of such professional mathematicians as are not without interest in the philosophical aspects of their science.

"To the growing class of such teachers of mathematics as endeavor to make the spirit of their subject dominate its technique.

"To the growing class of those natural-science students who are interested in the logical structure and the distinctive method of mathematics regarded not only as a powerful instrument for natural science, but also and especially as the prototype which every branch of science approximates in proportion as its basal assumptions and concepts become clearly degined. . . .

"To the rapidly increasing class of engineers who are learning to conceive engineering worthily, as the science and art of directing the civilizing energies of the world to the advancement of the welfare of all mankind.

"Finally, to all readers who desire to acquire a fair understanding of such genuinely great mathematical ideas as are accessible to all educated laymen."

Pictures That Talk
(*Continued from page* 19)

most delicate overtones—the very sounds that give quality to speech and music.

The reproduction of the sound from the film is accomplished by moving the film in front of an exceedingly delicate electrical device which produces electrical energy in direct proportion to the strength of light falling upon it. By an ingenious combination of vacuum tubes, there has been produced an apparatus which responds to variations in the light falling on it. There is said to be no sluggishness, as compared with selenium cells. The current is brought to amplifying devices and loud-speakers which can be scattered over a wide area if desired.

Recently the pallo-photo-phone was employed to operate the radio broadcasting station WGY of the General Electric Company. The well-known voice of the WGY announcer, KH, was recorded on a photographic film and sent out over the radio phone with such accuracy that it was almost impossible to distinguish it from the living voice as ordinarily transmitted from that station. Indeed, it appears very likely that such applications of the photographic recording of sounds will become quite common in the future, and that lectures and important speeches may be simultaneously broadcasted from several radio stations. This system has a definite application in recording speeches, songs and other sounds for future generations. Its application to the theater is, of course, obvious.

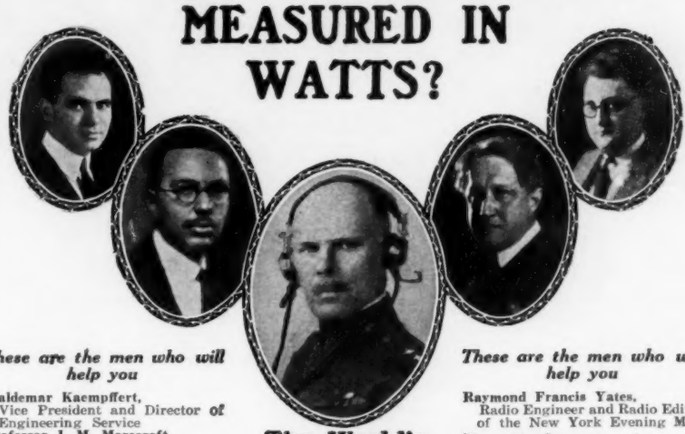
Our Aladdin's Lamp
(*Continued from page* 24)

amperes at 10,000 cycles, the filament excitation requiring about 20 kilowatts. The magnetic field produced by this large heating current from the cathode to the anode during a portion of each half cycle of the current, passing through the cathode, takes the place of that of the grid in the three-electrode tube. The electron current to the cathode is thus interrupted 20,000 times per second. By the use of properly tuned circuits this can be used for the production of high-frequency currents for radio or any other purpose. This particular type will supply 1000 kilowatts of 20,000-cycle frequency at an efficiency of 70 per cent, operating with an anode voltage of 200,000.

The New Conservation—II
(*Continued from page* 28)

existing in many of the articles used by their husbands, there would be fewer cartoons drawn depicting husbands fainting at the sight of the milliner's bill. For relatively, the cost of tools, lumber, paint, refrigerators, groceries, and numerous other items is much higher than necessary, despite the fact that wages, and taxes are high. And the reason

WILL CULTURE BE MEASURED IN WATTS?



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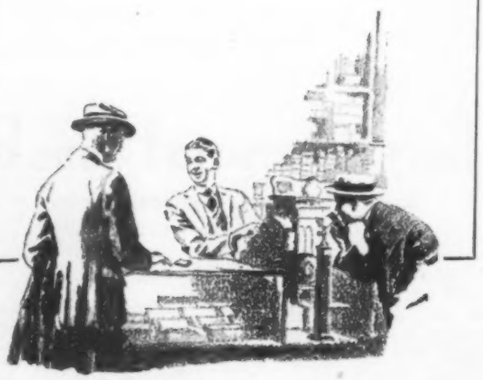

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The Jews in America

What are the facts about our Jewish population?
What part do they play in American life?
Is it true that they dominate American Finance?
Are they the brains of the Nation in Professions?
In education, in journalism, in literature, in music or the drama?
Are they increasing their influence in Politics?
Are they holding a disproportionate share of public offices?
How many Jews are there in this country?
Where did they come from?
Why did they come here?

These are only a few of the questions that must be answered before the fundamentals of the problem, and it is a problem, can be solved.

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is found in this great diversity of kind, model or pattern, and size in which each is offered for sale.

Unnecessary duplication, expressed in minute variations between different makes of articles of everyday use, is an economic waste. Any retailer can tell you at inventory time what goods sell best, what size package is most popular. His guide in his future purchases is the stock left on his shelves, for in the main, it consists of his slow-moving lines. They represent the handicap on his turnover to the extent of the capital originally invested in them. The clearance sale means the loss on these inactive lines must be absorbed on the prices charged for the goods that move more rapidly through the hands of his sales-people. It is that extra increment in the prices of current commodities which reflects waste, for it means an expenditure for which there is no return to the consumer. Jobbers, and manufacturers have identically the same problem to face, and their losses are passed along in the prices they charge their customers. The final purchaser being at the end of the line pays these accumulated "waste-premiums" and then wonders why the cost of living is so high.

Standardized goods sell the year round—manufacturers produce them during dull seasons for stock, knowing they will be sold eventually. This regularity of production brings stability of employment, and lowered costs of production. Selling prices can be proportionately revised downward, and as the purchasing power of a dollar thus increases, the cost of living is lowered.

Simplification is not a theory—it is a practical working medium by, and through, which these results can be attained. It has been tried and proven in a hundred different plants, and now groups of plants, turning out products of a common classification, are cooperating through their trade associations to bring to the industry as a whole those advantages the individual plants enjoyed. This is not done for philanthropic reasons, but is instead a manifestation of the typical American business spirit, viz., the adoption and use of new methods and principles because they pay!

Secretary Hoover measures the ultimate value of the Department of Commerce by its usefulness to the American people. He believes that if the Department can help American industries toward greater prosperity through cooperating with them to simplify their lines, eliminate wasteful trade practices and lower production costs, their markets will be broadened, and greater volume of business will result. Unemployment will be less frequent and of shorter duration, distribution will be facilitated, and costs of living will go down. Foreign competition will have fewer terrors for us, and our present high standards of living will be maintained.

The Division of Simplified Practice in the Department of Commerce is organized to help American industries reduce the wastes of over-diversification. Its main theme is conservation—the "New Conservation," embodying not only the old conservation of material resources, of money and of time, but also that greater and far more precious medium by which all our wants, whether necessities or comforts are supplied—human energy!

The New Conservation means a more prosperous America.

Airplanes in the Public Consciousness

(*Continued from page 32*)

Another Spad is labeled as being one of the first planes of this type issued for America during the World War. It was used during the engagements of Chateau-Thierry and St. Mihiel and during the Argonne operation, operated by Brigadier General William Mitchel, United States Air Service. General Mitchel also used it after the armistice, when piloting the Prince of Wales across the Rhine at Coblenz on an observation tour over the area occupied by American troops in Germany. It is equipped in every respect as it was during actual operation on the battlefield.

The famous German Fokker, most dreaded of the enemy planes, is represented by the U 10, model D VII. This plane was captured at Verdun two days before the armistice, by Captain H. McLanahan and Lieuts. E. Curtiss and S. Sewall of the first pursuit group 95th Aero Squadron. It has a Mercedes 180-horsepower motor, travels 116 miles per hour and remains aloft for two and a quarter hours on only 21 gallons of fuel. Two Spadan machine guns make it deadly and a curious cubist sort of camouflage, of dainty, delicate colors in six-sided lozenges makes it difficult to see. That Fritz was not without his sense of humor is illustrated in the bucking mule painted with more virility than veracity upon one side of the fuselage.

Still another historic plane is Captain Street's D. H. 4, which flew from New York to Alaska and back to Washington, a distance of 9,000 miles, without trouble or mishap.

A most interesting exhibit is the Le Pere tractor biplane, developed by the United States Air Service for fighting. A 400-horsepower Liberty motor provides a speed of 136 miles per hour and 72 gallons of gasoline give it two hours radius. Two Lewis and two Marlin guns provide its offensive power. Particularly interesting is the stream lining of the struts and wire braces, the latter double, and with a wood insert between them to diminish wind resistance.

Finally there is an aeromarine 39 B seaplane, provided with a Curtiss 100-horsepower motor which gives a speed of 68 miles an hour. The little craft is manned by a crew of two. Landing at forty miles an hour, if descent upon the water can be said to be "landing," the small craft can climb 1,500 feet in ten minutes. It has a ceiling of 6,300 feet.

Auxiliary exhibits include flying suits, both electrically warmed and plain, and two of historic interest, one worn by General William Mitchel and the other by the Prince of Wales.

Guns are represented by a Lewis, exhibited alone in its glass case, and a Marlin also separately displayed. An exhibit of interest shows twenty-two bottles of "wing dope," giving some idea of the details requiring attention in making a plane.

A number of engines are on view. First, of course, is the Liberty. Three examples are shown, besides those on the planes, one complete, one a crank case only, and one complete but cut away to show moving parts. Few people are unfamiliar with the Liberty motor, at least as a name, but here they have a chance to see the outstanding product of American engineering during the war in detail, and to appreciate something of what is meant when they read that it has 12 all-steel cylinders; bore 5 inches; stroke 7 inches; piston displacement 1,650 cubic inches; weight 885 pounds, and 420 horsepower at 1,700 revolutions per minute.

The Liberty motor is equipped with two carburetors situated between the V made by the cylinders. One feeds the six cylinders towards the propeller end and the other the six rear cylinders. Ignition is supplied by a storage battery.

A feature of the Liberty motor well shown here is the lubrication of the crankshaft bearings. Because of the many positions which an airplane may take in flight, such as nose-dive, tail-spin or upside down, the "splash" system in which the shaft and bearings are partly immersed in oil as in the majority of automobile engines, cannot be used. In its stead oil is supplied to the bearings through a hollow crank shaft, easily seen in the cut away model because the oil passages are painted red. Oil issuing from the bearings is whipped into a spray by the fast revolving shaft and lubricates other working parts. The excess oil eventually condenses and flows to the sump in the bottom of the crank case, from which it is drawn to the oil pump and used over again.

In addition to the Liberties, there are a couple of Hispano Suiza engines of 150 and 200 horsepower respectively; a Curtiss of 90 horsepower, and a Bugatti of 16 cylinders with twin shafts and two nine-cylinder Gnome rotaries.

For those who are interested in the fighting equipment of the planes, a De Haviland fuselage has been separately mounted in a case, so that the inquirer may come close to and examine minutely the hydraulic synchronizing gear for the guns, which enables them to shoot between the propeller blades, and the mounting of Lewis guns on the double flexible yoke.

It will hardly be contended by the Museum authorities that the exhibit is complete, or that it is as extensive as it may become. But the very simplicity of it, plus the magnitude of the great wing spreads, and the multitudinous details revealed by skeletonizing the fuselages and wings of the planes thus treated, makes it of the highest educational value. It hardly needs to be said that in addition it becomes, with every passing year, of increasing historic value.